1957

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REPORT

OF THE

Department of Scientific and Industrial Research

FOR THE YEAR ENDED

31 MARCH 1958

Presented to the House of Representatives by Leave

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MINISTER'S STATEMENT

The reports of the Department of Scientific and Industrial Research and of the Council of Scientific and Industrial Research for the year ended 31 March 1958 are presented herewith.

I wish to record my appreciation of the work of members of the council who have given generously of their time to the consideration of important matters of scientific policy and to the special functions required of them under the Scientific and Industrial Research Act. Dr M. M. Burns, Dr G. A. Currie, and Mr D. M. Rae retired during the year after completing their terms of office. I should like to thank them for their valuable services and to welcome Mr A. F. Downer, Mr Charles Hilgendorf and Mr A. H. Ward, who have replaced them on the council.

The Department has continued to devote substantial effort to the work of the International Geophysical Year in this country, the Pacific islands, and Antarctica. The work at Scott Base and at the joint United States - New Zealand station at Cape Hallett has absorbed a major portion of this effort in which the New Zealand station at Invercargill has also played a prominent part. The significance of New Zealand's contribution was made clearly evident at the Antarctic symposium held here during February 1958. On this occasion upwards of 45 scientists from seven nations met with New Zealand scientists to discuss their Antarctic endeavours of the previous 12 months.

From the Secretary's report and those of the branches it will be seen that the work covers a wide field of research and service and that the Department is making a valuable contribution to the economic well-being of the country. The high standard of agricultural productivity in this country is in a considerable measure due to the application of the results of scientific research in which the Department has played a prominent part since it was established just over 30 years ago.

Our concern with agricultural research and development extends beyond the shores of New Zealand itself to its territories in the Pacific islands. As a result of a joint recommendation by the Department of Scientific and Industrial Research and the Department of Island Territories, a senior officer of my Department visited the islands to make a general assessment of the agricultural problems that will have to be overcome if production is to meet the requirements of growing populations and provide the means to satisfy the need for modern services and amenities. As a result of this survey, the Department will be able to decide in what ways, and how far, it can assist with agricultural development in these territories.

Recent economic events have drawn attention to the need for increased development of manufacturing industry side by side with agricultural production. The benefit of applied science in agriculture has already been demonstrated and no less is the application of scientific methods and the results of research necessary for the development of healthy manufacturing industry. I believe that, without diminishing

its activities in agricultural research, the Department of Scientific and Industrial Research, with its resources of skilled scientific and technical staff and equipment could, with even a modest addition to these resources, make a much greater contribution to technological progress in industry than it is now able to do.

During January, Professor J. P. Baxter, Chairman of the Australian Atomic Energy Commission, and Sir Leslie Martin, Professor of Physics at the University of Melbourne, visited New Zealand at the joint invitation of Government and the University of New Zealand to report on the development and organisation of nuclear science in New Zealand. Their report is at present being studied by the Department and the University as a basis for formulating proposals to Government.

I should like to thank the staff of the Department for their loyal service during the year and express my appreciation of the work they are doing.

P. N. Holloway,

Minister in Charge of the Department of Scientific and Industrial Research.

REPORT OF THE COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

The Hon. P. N. Holloway, Minister in Charge of the Department of Scientific and Industrial Research.

We have the honour to submit herewith the report of the Council of Scientific and Industrial Research for the year ended 31 March 1958.

The council consists of a chairman and not more than eight other members, not more than two of whom may be "officers employed in the service of the Government". The membership of the council at 31 March 1958 was:

D. F. Sandys Wunsch, O.B.E., M.A.(Oxon), B.Sc.(McGill), M.I.Chem.E., Assoc.Inst.M.M., F.N.Z.I.C. (Chairman).
F. J. Llewellyn, Ph.D., D.Sc.(B'ham), F.R.I.C., F.N.Z.I.C., F.R.S.A. (Deputy Chairman).
J. Andrew, C.B.E.
A. F. Downer, C.B.E., M.I.C.E., M.N.Z.I.E.
J. F. Filmer, D.V.Sc.(Melb.), H.A.R.C.V.S.
C. Hilgendorf, M.A.
Sir Ernest Marsden, C.M.G., C.B.E., M.C., D.Sc.(Manc.), Hon.D.Sc. (Oxon), M.I.E.E., F.R.S., F.R.S.N.Z.
A. H. Ward, A.R.A.N.Z.
J. S. Watt, M.Sc.(N.Z.), D.Phil.(Oxon).
W. M. Hamilton, M.Agr.Sc., D.Sc., N.D.H.(N.Z.), (Secretary).

Dr M. M. Burns, Dr G. A. Currie, and Mr D. M. Rae retired on rotation on 31 December 1957, and the vacancies were filled by appointment of Mr A. F. Downer, Mr Charles Hilgendorf, and Mr A. H. Ward for a period of four years from 1 January 1958.

Five meetings of the council were held during the year, and its various committees met regularly. The council wishes to take this opportunity of expressing its appreciation of the valuable work done by members of its committees.

RESEARCH GRANTS TO BODIES OUTSIDE THE DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH

The council continues to recommend annual grants to research workers in the universities and to other institutions to encourage research, frequently in subjects ancillary to the main programe of the Department of Scientific and Industrial Research.

Each of the two agricultural colleges has, for instance, received grants of from £6,000 to £8,000 annually for some years to support research into a large number of problems concerned with soils, farm plants, and animals.

At the universities the council supports with substantial grants a number of research projects such as radio research at Auckland, research into meteor showers at Canterbury, and the Industrial Development

Department at the University of Canterbury. At Victoria University of Wellington it meets a considerable part of the cost of the special investigations of ironsands.

The grants to universities, including the colleges of agriculture, have for some years amounted to approximately £30,000 annually and moneys so spent enable a large amount of research to be carried on by members of university staffs and others who would be severely handicapped in their work without this aid.

In addition to those for university research, grants are made to allied institutions, to research institutions, societies, and associations. At the Cawthron Institute in Nelson and at the seven incorporated research associations such grants provide approximately half the total funds available.

Altogether, including grants to universities, research institutions, and otherwise, the Council of Scientific and Industrial Research recommends annually the expenditure of over £140,000 to assist research or the work of organisations concerned with research. These grants, although met from the vote of the D.S.I.R., are outside the regular programme of research and scientific services of the Department itself.

Details of the grants paid last year are as follows:

Grants Paid in 1957–58 to Research and Allied Institutions

	£	£
A.N.Z.A.A.S.		1,434
Canterbury Agricultural College		6,000
Massey Agricultural College		8,000
Cawthron Institute		10,996
Carter Observatory—Statutory	2,250	
IGY	500	
		2,750
Royal Society of New Zealand		4,000
Commonwealth Agricultural Bureaux		18,680
U.K. National Institute of Oceanography		2,500
C.S.A.G.I. (IGY controlling body)		250
Royal Society and Nuffield Bursary Scheme		200
Scott Polar Research Institute		100
Incorporated Research Associations—	£	
Dairy Research Institute	30,074	
Meat Industry Research Institute	18,267	
New Zealand Fertiliser Manufacturers Research Association	4,250	
New Zealand Leather and Shoe Research Association	5,400	
New Zealand Pottery and Ceramics Research Association	5,500	
New Zealand Wool Industries Research Institute	6,650	
Research Institute of Launderers, Drycleaners, and Dyers of New Zealand	5,400	
		75,541
University of Auckland (Seagrove)		3,500
University of Canterbury—		
Industrial Development Department	3,000	
Radio Research (Meteors)	1,500	
IGY	200	
		4,700
Victoria University of Wellington—		
Ironsands investigations		2,000
Special Soil Investigations		380
		£141,031

RESEARCH ORGANISATION

The council has for long been aware of defects in the present organisation of research activities in New Zealand, but has been able to do little to overcome them within its present Act.

It feels that the time has come when some modification of the Scientific and Industrial Research Act 1952 would be desirable and should be considered by Government. It is therefore again studying the subject and hopes to be in a position this year to make recommendations on this important matter.

As one necessary preliminary, panels of the council are making a close study of each of the major activities of the D.S.I.R., and should complete the survey this year. So far the panels are, in general, very satisfied with the high quality of the staff, the work they are doing, and its great value to New Zealand. They have been particularly impressed by the extremely close and friendly collaboration existing between individual workers in the research units and also between the various units themselves: collaboration which results in the whole of their scientific knowledge being readily available to help in the solution of any problem which presents difficulties to the man or the group directly concerned with it. There are also many cases of close and helpful collaboration with workers in other organisations and an extension of these contacts would be highly desirable. There is little need to stress the necessity of such collaboration for the solution of the many difficult scientific problems which must be solved to enable the full development of our natural resources.

ACCOMMODATION

Improvement in the accommodation of certain branches is essential for efficient working. The new accommodation for Geological Survey provides ideal conditions for the staff to produce results which are of great and increasing value to New Zealand. The new quarters are a contrast to the old buildings, provide safe storage for the valuable specimens and records, and should suffice for the increasing work of the Survey for some years.

Other new buildings are under way, but there remains a number of cases where the working conditions vary from poor to bad. These are not only discouraging to the staff, who have to work under uncomfortable and crowded conditions, but, in some cases, are a hindrance to the work itself and council hopes that it will be possible to continue and to expedite the building programme which it considers to be necessary. The matter becomes of increasing urgency if effect is to be given to the highly desirable object of increasing scientific aid to the manufacturing industries of the country.

ASSISTANCE TO INDUSTRY

For many years the Manufacturers' Research Committee of the council has endeavoured to increase the application of research and of scientific methods in the manufacturing industries. It has found that the most satisfactory method of attaining this end has been to encourage the formation and development of incorporated research associations, with finance provided jointly by the industry concerned and the State, and controlled by committees representing both, with a majority of industrial members.

The Manufacturers' Research Committee has recently concluded a close inspection and investigation of the work being carried out by these associations, and in general has been very satisfied with the quality of their work and its value to the industries concerned. This value should continue to increase, leading to higher outputs and higher quality goods. In most cases the committee has recommended some increase in the basic contribution by the industry which is matched by an equal sum from the State; contributions by industry above the basic level carry a 50 per cent State subsidy. This system has proved to encourage a much more direct interest by manufacturers in research and its application than would a wholly State financed and controlled organisation. Results from research go far more rapidly into use in the form of improved methods and process control – and a research result is valueless to an industry until it does so.

Nevertheless, the committee believes that, with New Zealand relying more and more upon her manufacturers, the time has arrived for a considerable extension of the other means already available of providing them with scientific aids. There are many cases where a research association would be inappropriate or premature, and the country cannot afford to allow any of its potentially efficient industries to languish through lack of readily available scientific aid. The Manufacturers' Research Committee is continuing to study the means by which this help can best be made available. Progress can only be gradual, but it should be continuous. It is recognised that the provision of these services will finally cost quite considerable sums but they will be far less than the hidden cost to the country of maintaining a number of unnecessarily inefficient industries.

The methods of affording State aid, which have done so much to bring agriculture to its present high state of efficiency, are not directly applicable to the more complex problem of aiding the very diverse range of more competitive manufacturing industries. However, there is little doubt that somewhat similar measures could do much to aid the establishment of any industries suited to New Zealand conditions, and could introduce improved methods in many of those already here. As with agriculture, expenditure on research will be recouped many times over by its results in improved quality and lower real costs of manufacture.

NUCLEAR SCIENCE

Council has considered the question of how New Zealand should meet the problems arising from the very rapid development of nuclear science. It is clear that we could find neither the money nor the men to undertake research in this field on a scale at all comparable with that of larger countries, but it does seem necessary to increase and extend the work now being carried out by the Division of Nuclear Sciences of D.S.I.R. and by the universities. Changes and improvements in the design of power reactors are proceeding with great rapidity and any in use today are likely to be out of date in a very few years' time. For this reason it is desirable for New Zealand to defer the introduction of atomic power until it is economic compared with other sources of power. Nevertheless, the time will come when power reactors will be installed here, and we must have men of our own who can handle them, for such men are, and will be, very scarce. More are needed already for immediate applications of nuclear science here.

We must, therefore, install and operate apparatus which will enable us to do some research on the problems of nuclear science and use the techniques of nuclear science for the solution of other present and future problems, for aid to industry and to provide a training ground for nuclear scientists. This apparatus will be costly and an expenditure of some £500,000 must be envisaged to meet New Zealand's needs.

RESEARCH EXPENDITURE

D.S.I.R. expenditure since 1949–50 is shown in the summary below, together with a column showing expenditure as a percentage of the gross national product (national income).

Year	Staff at 1 April		Gross Expenditure	Gross National Product	D.S.I.R. Expenditure as Percentage of National Product
	Professional	Total			
			£(000)	£(m.)	
1949–50	363	939	959	556	0·173
1950–51	390	981	962	696	0·138
1951–52	386	997	1,096	722	0·152
1952–53	402	1,012	1,010	754	0·134
1953–54	374	931	1,089	837	0·131
1954–55	374	937	1,149	923	0·124
1955–56	372	928	1,213	982	0·123
1956–57	366	946	1,404	1,024	0·137
1957–58	369	972	1,535	*	*

* Figures not available.

From this summary a number of points emerge which cause council some concern. It is clear from the above figures that total staff numbers employed by the Department have remained substantially static over the past nine years; this during a period when the "gross national product" has nearly doubled and there has been a rapid growth in population. The professional staff at 31 March 1958 was 383, but in spite of this increase of 14 during the year, the Department at this date was employing 19 fewer professional officers than six years previously.

During the period from 1949–50 to 1957–58 the total funds available to the D.S.I.R. have increased by £576,000, of which £420,000 has been absorbed in increased salary charges while grants to other organisations, such as research organisations, universities, etc., have increased by £68,185. The amount available to the Department for expenses other than salaries and grants has increased from £410,966 in 1949–50 to £499,000 in 1957–58 – an increase of only 21 per cent during a period in which the retail price index has increased by over 50 per cent. In terms of purchasing power, last year's allocation of funds for expenses other than salaries and grants is substantially smaller than it was in 1949–50.

We cannot emphasise too strongly that in our opinion the future development of New Zealand depends very materially on scientific research and development. In a time when science is fundamental to the development of our resources and to increasing productivity in both primary and manufacturing industries, we should be *increasing* not *decreasing* the percentage of the national income applied to scientific work.

DEPARTMENTAL EXPENDITURE AND STAFFING

Expenditure by the Department in 1957–58 is shown in the table below:

Table of Expenditure 1957–58

—	Staff 31 March 1958	Salaries	Other Expenditure	Total Expenditure 1957–58	Voted 1957–58
		£	£	£	£
Head Office	68	62,520	12,698	75,218	73,760
Animal Ecology Section	8	7,630	3,114	10,744	10,050
Applied Mathematics Laboratory	18	17,160	1,869	19,029	18,520
Auckland Industrial Development Laboratories	31	29,704	12,481	42,185	40,840
Botany Division	23	20,490	8,093	28,583	26,300
Crop Research Division	51	40,554	19,487	60,041	59,300
Dominion Laboratory	146	126,633	64,032	190,665	187,500
Dominion Physical Laboratory	154	125,513	56,216	181,729	177,130
Entomology Division	23	19,711	10,440	30,151	28,650
Fats Research Laboratory	18	15,446	4,883	20,329	20,600
Fruit Research Division	25	22,575	19,992	42,567	41,920
Geological Survey	74	62,155	29,356	91,511	91,050
Geophysics Division	82	74,081	96,136	170,217	166,610
Grasslands Division	74	57,287	38,527	95,814	93,440
Hop Research Station	4	3,590	3,256	6,846	7,350
Information Bureau	23	20,023	18,602	38,625	43,360
Nuclear Sciences, Division of	22	16,915	11,293	28,208	23,920
Plant Chemistry Division	26	21,511	13,863	35,374	34,100
Plant Diseases Division	57	52,163	25,227	77,390	78,750
Scientific Liaison Service	6	5,688	5,935	11,623	14,120
Soil Bureau	75	73,644	22,455	96,099	90,810
Tobacco Research Station	6	5,103	7,137	12,240	11,520
Wheat Research Institute	9	8,455	2,260	10,715	11,680
Research General	..	..	10,032	10,032	10,800
Scholarships	..	..	7,638	7,638	8,100
Miscellaneous	..	..	330	330	500
Grants—					
Universities and agricultural colleges	..	..	24,200	24,200	28,700
Incorporated research associations	..	..	75,541	75,541	75,544
Statutory and miscellaneous	..	..	41,290	41,290	42,806
	1,023	888,551	646,383	1,534,934	1,517,730
Less recoveries	..	..	..	50,988	53,940
Net expenditure	..	..	..	1,483,946	1,463,790

The actual staff employed on 31 March 1957 was 969 and by 31 March 1958 this had increased to 1,023.

The staff at 31 March 1958 (figures for previous year in parentheses) comprised professional 383 (369); clerical 165 (160); technical 410 (378); others 65 (62).

D. F. SANDYS WUNSCH, Chairman.

SECRETARY'S REPORT

The Hon. P. N. Holloway, Minister in Charge of the Department of Scientific and Industrial Research.

I have the honour to submit herewith the annual report of the Department for the year ending 31 March 1958.

On 20 February the Right Honourable the Prime Minister officially opened the new offices of the Geological Survey at Lower Hutt. These offices occupy the top three floors of the new State Fire Building and, for the first time, provide modern, fireproof accommodation for the Survey and its valuable collections.

During the year a substantial part of the Dominion Laboratory has been shifted to new buildings on the Gracefield site in order to make way for the new Government building being erected in Bowen Street. It is hoped that additional buildings can be erected at Gracefield in the near future in order to complete the move of Dominion Laboratory from Sydney Street.

Tenders were let in March for a new building of approximately 15,000 sq. ft. at Lincoln to house the Botany Division. The building will also provide space for the Entomological Research Substation, which is being transferred from Ashburton, and for the Grasslands Substation. The building is being erected in fireproof materials and the plans include provision for adequate herbarium and library space as completely fireproof as possible. It is hoped that the building will be completed and ready for occupation in 1959.

At the same time a number of units of the Department, such as Soil Bureau and Fats Research Laboratory, are still housed in old and unsuitable accommodation. The tempo of new building needs to be accelerated if the Department is to overtake arrears of the last 20 years and provide for new developments such as nuclear science.

RESEARCH

In the following section a brief review of work completed during the year is given. Items that appear to be of general interest have been selected and are outlined in non-technical terms with sufficient background information to explain the significance of the work. No attempt has been made to cover all work completed, but a complete list of all scientific papers published during the year is given following the list of projects in each branch.

SCIENTIFIC ACTIVITY IN ROSS DEPENDENCY AND IGY

In February Government approved the continued operation of New Zealand bases in the Ross Dependency after the end of the International Geophysical Year on 31 December 1958. In March, Government took steps to implement this decision and decided that the Minister in Charge of Scientific and Industrial Research should have responsibility for coordinating all New Zealand activity in the Ross Dependency and that the Department would coordinate executive action and perform any executive acts not clearly the responsibility of any other Government Department or authority.

Government also appointed a Ross Dependency Research Committee to advise and assist the Minister in carrying out these functions. This committee includes representatives of the universities, Royal Society of New Zealand, Dominion Museum, and Government Departments, and is now engaged on formulating the 1958–59 programme.

Geological and Survey Work—The New Zealand Geological Survey, taking advantage of the extensive IGY activities in the Ross Dependency and the generous offers of transport facilities by the United States Navy authorities of Operation Deepfreeze, decided to extend its regional mapping to the Ross Dependency. Cape Hallett, on the Ross Sea coast of Victoria Land, 70 miles south of Cape Adare, was selected as the initial area of operations. This selection was based on two considerations, one the presence of a joint New Zealand - United States base at Cape Hallett and the other because it is a key area as far as geology is concerned, for it could link the pioneer work to the north of Cape Adare with the present work to the south. Accordingly, an expedition was formed, equipped, and provisioned within less than five months, and left New Zealand on 22 November 1957 on the icebreaker U.S.S. *Atka*. The expedition was charged with the task of both topographic and geology surveys of as great an area as possible within the limits of manhauling from Cape Hallett. A surveyor, seconded from Lands and Survey Department, was included with an additional surveyor and assistant from outside the service, and, together with four geologists and a photographic officer from D.S.I.R., completed the party of eight. This was the first fully governmental expedition to work in the Dependency carrying out its normal duties. The geological mapping of the Ross Dependency is regarded simply as a part of the overall task of preparing a geological map of New Zealand and its dependencies. The New Zealand Geological Survey field party of eight men explored and mapped the district lying mainly west and south of the station for seven and a half weeks between December 1957 and February 1958.

The expedition arrived at Hallett from McMurdo in two flights of United States Air Force Dakotas, after travelling from New Zealand on the icebreaker U.S.S. *Atka* to Little America and then to McMurdo in the U.S.S. *Glacier*. Hallett Station at first sight looks an unpromising base for a trail party, being closed in by sea and mountains. However, shortly before sailing date some distant air photographs were received from the U.S. Navy and these showed a major valley glacier, Tucker Glacier, flowing into Tucker Inlet some 30 miles south of the station and extending back to the plateau. They also indicated a pass leading from Hallett Bay to the glacier.

Shortly after arrival a six-day reconnaissance northwards across the sea ice to Moubray Bay was made to link up with work done some 50 years ago by the Borchgrevinck party and Scott's northern party. At the same time, with the aid of a Weasel, the other team established a depot at the head of Hallett Bay; this depot was later man-hauled to the top of the 2,000 ft. Football Pass leading to Tucker Glacier to become the main forward depot.

The second and main phase of the expedition began with the party descending from Football Pass to the Tucker Glacier and proceeding up this glacier toward the plateau. The two teams man-hauling gear and stores worked in this area – one for geology and one for surveying.

The furthest point reached was 66 miles from the Football Pass and 80 miles from the sea. Four men climbed two peaks about 9,500 ft., called Mount Midnight and Mount Shadow. The party, on returning to Hallett Station, was picked up by the U.S.S. *Glacier* and returned to New Zealand. As a result of the photo-theodolite survey work carried out, the maps will cover an area of some 6,000 square miles with an accuracy fairly high in the central part of about 1,500 square miles but fading away towards the margins. The same can be said for the regional geological mapping as detailed knowledge gained in the field can now be used to interpret geology from the photo-theodolite pictures and thus extend the area mapped geologically.

Geomorphologically the district is divided into two parts by a topographic corridor of low elevation trending southwards for over 100 miles from Robertson Bay, on the west side of Cape Adare, to the Lady Newnes Ice Shelf. East of the corridor there is a line of three major volcanic domes or shield volcanoes rising to 5,000 ft. or more above sea level and elongated parallel to the coast. West of the corridor, the Admiralty Mountains of early Paleozoic or Pre-Cambrian rocks rise abruptly to heights between 10,000 and 12,000 ft. and extend inland for over 100 miles, gradually fading to nunataks nearly submerged beneath the ice of the plateau. A large part of the Admiralty Range is drained by the Tucker Glacier and its tributaries, flowing from the plateau to enter the Ross Sea at Tucker Inlet, 30 miles south of Cape Hallett.

For topographic mapping, 20 permanent survey stations were established on high prominent rock features around parts of the corridor and Tucker Glacier, their positions being determined by sun-shots. Details were filled in by rounds of angles and photographs taken with a photo-theodolite.

The Early Paleozoic or pre-Cambrian rocks of the Admiralty Mountains are divisible into two distinct groups.

Moubray Group consists of quartzose greywacke and argillite, meta-greywacke and meta-argillite, biotite-schist, hornfels, and minor limestone folded on west-north-west axes. The more altered rocks have been mineralogically reconstituted but without much change in grain size except for the occasional development of garnet porphyroblasts, and without the development of prominent schistosity and metamorphic differentiation. Larger-scale sedimentary features such as bedding and smaller-scale features such as cross-bedding and graded bedding are well preserved even in the most metamorphosed rocks. Folds trend predominantly to the west-north-west, and small drag folds with a wavelength of a few yards to half a mile are developed on the limbs of larger folds with a wavelength of several miles which in turn might be drag folds on the limbs of larger structures. The steeper limbs of some folds in many places pass into small thrusts. (In all these features the rocks of Moubray Group resemble the Lower Paleozoic rocks of Cunaris Group in Fiordland New Zealand.)

The second group of rocks in the Admiralty Range is the Tucker Granodiorite. It consists predominantly of hornblende-biotite-granodiorite with accessory granite, aplite, and diorite, and is cut by lamprophyre and microdiorite dykes. The rocks occur in three main masses which have intrusive contacts, in part hornfelsed and in part assimilated, with Moubray Group, and cut across the fold axes and

bedding of Moubray Group at high angles. At least one mass, in the lower Tucker Glacier, has a sheet-like form and is about 7,000 ft. thick. It has been gently warped, probably about an axis trending west-north-west. Traces of copper mineralisation are common in the Tucker Granodiorite and particularly close to highly siliceous dykes, but no ore of economic grade has been found.

A deformed and dissected peneplain, possibly of Late Cretaceous or Tertiary age, extends across the Admiralty Mountains, and near the coast dips sharply beneath the Ross Sea and the line of basaltic shield volcanoes. The Ross Sea is probably a relative young feature, about Late Tertiary in age, and its western margin is a monoclinal scarp rather than a fault scarp.

The coastal basalt domes or shield volcanoes have been built up by eruptions since the Late Tertiary or Early Quaternary and consist predominantly of olivine-basalt, hornblende-basalt, and minor trachy-basalt, phonolite, and trachyte. The existence of cinder cones that have not been greatly modified by erosion suggests that eruptions have occurred within the last few thousand years. Basaltic ash is contained in a low-level moraine on the west shore of Hallett Bay.

Raised beaches and older moraines have not been found in the district, but the occurrence of granite erratics at a height of 1,500 ft. on the Cape Adare basalt dome is evidence of at least one much more intense Quaternary glaciation, which probably involved extension of piedmont ice far into the Ross Sea.

The discovery that most of northern Victoria Land consists of the rocks of Moubray Group quite alters the general picture of Ross Sea geology, and particularly the statement commonly made that Antarctica is divided into two subcontinents of quite different geology by a line from the Ross Sea to the Weddell Sea. The sediments of Mourbray Group in Victoria Land strike towards Marie Byrd Land on the other side of the Ross Sea, where there are large areas of comparable rocks of the same strike. It is a reasonable working hypothesis that the two sets of rocks can be correlated and are continuous beneath the Ross Sea, which in turn implies that Antarctica is geologically one continent.

It is hoped that in the 1958–59 summer season geological reconnaissance can be continued in the area to the south of Cape Hallett to link up with earlier surveys and the work carried out by members of the Trans-Antarctic Expedition in 1957–58.

International Geophysical Year—A considerable proportion of the Geophysics Division's activities have been diverted to the IGY programme again this year. However, it is pleasing to be able to report that the IGY stations in New Zealand, the Pacific islands, and Antarctica are operating efficiently and the data are now being forwarded regularly to the world data centres.

The seismological, ionospheric, geomagnetic, auroral, radio propagation, meteorological, and tide gauge programmes were working efficiently at Scott Base and Hallett Station in the Ross Dependency prior to the commencement of the IGY on 1 July 1957. The high standard of work maintained throughout the year at both stations has earned the praise of scientists from other countries who visited the stations during the 1957–58 summer.

In January 1958 the first-year party at Scott Base under Dr T. Hatherton was relieved by the second-year party of 11 men under L. H. Martin, of the National Broadcasting Service. This team includes an Italian observer, Lieutenant Franco Faggioni, who is a hydrographic officer with experience in geophysics. The three New Zealand scientists at Hallett Station were also relieved in January 1958. The operation of this station jointly by the United States and New Zealand has been extremely successful. Professor J. Shear, an American, was chief scientist the first year and K. J. Salmon, a New Zealand engineer from Air Department, will hold this position the second year.

When officers of the United States IGY National Committee passed through New Zealand last year it was suggested that informal meetings between New Zealand and United States scientists returning from Antarctica should be arranged in Wellington during the 1957–58 summer. Following interest by other countries, the idea was broadened to include all nations undertaking Antarctic research, and formal invitations to attend such meetings were issued to IGY committees of 11 countries by the New Zealand National Committee for IGY. The Antarctic scientists of New Zealand met with 40 scientists from Australia, France, Great Britain, South Africa, U.S.A., and U.S.S.R. at a symposium on Antarctic research held in Wellington during 18–22 February 1958. The scientists were welcomed to New Zealand by the Prime Minister, who expressed the hope that future Antarctic work might continue in the same cooperative spirit as IGY.

Since returning to New Zealand, the first-year Antarctic parties have been analysing their data for transmission to IGY world data centres and for publication in scientific journals.

Study of the Aurorae—Many of the radio paths that link New Zealand with other countries pass through or near to the zones of aurorae that ring the northern and southern magnetic poles. When aurorae are active, radio signals often fail to pass through these regions. New Zealand's part in IGY includes a study of aurorae and of their effect on the passage of radio signals. The Dominion Physical Laboratory has built an automatic radio transmitter which is installed at Scott Base, Antarctica, and whose signals are being recorded automatically at places in New Zealand, Tasmania, and on the Antarctic continent. With the assistance of Carter Observatory and the universities, the laboratory has also set up a temporary scientific station at Invercargill, the purpose being to keep a watch on aurorae by as many methods as are practicable.

A radar set has been installed on the top of Bluff Hill, Invercargill. Echoes from aurorae may appear on the radar screen up to distances of 750 miles (1,200 km.), beyond which they are thought to be hidden by the earth's curvature. Spectroscopes are operated at Invercargill to record the nature of the auroral light. Photographs of the visible aurorae are made on an "all sky" camera. The experiments with the radar have shown that the reflections of the radar beam come from a layer only a few kilometres thick, about 70 miles (110 km.) above the earth, and they indicate that in this region the atmosphere is ionised along tracks parallel to the direction of the earth's magnetic field. Perhaps these are tracks left by protons arriving from the sun. The regions that reflect the radar beam are not the same as those that glow visibly during auroral displays and the two do not necessarily occur

at the same time. Which of the two it is that absorbs the radio signals is not yet known, but the experiments will give a better understanding and control of the transmission of radio signals past the poles.

Radio "Whistlers" and "Dawn Chorus"—Within the last few years a method has been found for investigating the properties of the ionosphere up to distances of several thousand kilometres from the surface of the earth. This is the study of a certain type of low frequency radio atmospheric ("whistlers"). Work at the Dominion Physical Laboratory in conjunction with that of Dartmouth College, U.S.A., has confirmed that these signals emanate from lightning flashes in the lower atmosphere, and pass far out into "space" travelling along the earth's magnetic lines of force and so return to earth at the point on its surface conjugate to the point of origin. This guiding occurs because the atmosphere extends all along this path. The ionised atmosphere both guides the signal and separates the frequencies in such a way that on return to earth it is a prolonged falling tone. From its character much can be deduced about the strength of the magnetic field and about the temperature and density of ionisation in the atmosphere at these great distances. The information has a bearing on the manner in which the atmospheres of the earth and sun are to some extent interconnected. Thus it appears from the last year's work that the state of the outer ionosphere fluctuates with the sun's activity but shows a delay in time amounting to about six weeks, whereas the corona (much nearer the sun) is reported to show a delay of about three weeks.

A further kind of low-frequency radio signal which occurs naturally has been called the "dawn chorus" from its resemblance to bird song. Work at Dominion Physical Laboratory has shown that this activity is related to activity on the sun. The immediate cause is still unknown. These inquiries rank as basic research related to the practical matters of radio communications.

POZZOLANS

Although the use of pozzolans dates back to the days of the early Romans, with Portland cement available as a major constructional material they have, until the last few years, found only limited use.

A pozzolan is a finely divided siliceous material which, though not cementitious in itself, will combine with lime at ordinary temperatures and, in the presence of water, form stable insoluble compounds possessing cementing properties. The modern practice is to replace 15–35 per cent of the cement in concrete by pozzolan. This may be done at the mixer or, alternatively, the pozzolan may be blended with Portland cement after its manufacture and the product marketed as a Portland-pozzolan cement. This latter practice is followed in some European countries. Pozzolans are still being used today with lime alone, for instance pozzolan/lime in the ratio of $3\frac{1}{2} : 1$ was used in the construction of the large dry-dock at Naples. Pozzolan concretes have greater resistance to sea-water corrosion than normal concretes. Hence, in Italy, where pozzolans are freely available, the use of pozzolans in the building of marine structures is compulsory.

The value of a pozzolan as a concrete admixture has been more fully realised as the problems associated with the use of Portland cement alone have been recognised. Greatest advantages in its use are to be gained in mass concrete for hydro construction. It is effective in

eliminating three serious defects which may arise with the use of a plain concrete. Firstly, since it replaces part of the cement and does not generate much heat itself, the heat of the hydration of the cement, which leads to volume changes in the concrete, stresses, and possible cracking on cooling, is considerably reduced. Secondly, where there is a danger of expansion of concrete resulting from the interaction of alkalies in the cement with reactive constituents in certain aggregates, this action may be eliminated by the use of a pozzolan. The aggregates available for use in some of the Waikato hydro schemes are classed as "reactive" and have been a factor in the decision to use a pozzolan in future projects. Finally, since lime is liberated during the normal hardening process of concrete, instead of being leached out of the concrete it combines with the pozzolan to give a denser, stronger concrete.

Work on the evaluation of natural materials occurring in New Zealand to determine their pozzolanic properties was begun in 1951. Of a wide range of materials tested it was found the two most promising types of pozzolan in this country are diatomite and pumicite. Two diatomites and two pumicites were selected for pilot-scale tests in actual concrete mixes. Of these materials, three were from the Waikato area, the fourth from North Otago. The more comprehensive tests confirmed their suitability, and demonstrated the greater reactivity of diatomite compared with pumicite. Numerous physical measurements gave information regarding the effect of the materials on the properties of plastic and hardened concrete, showed the optimum percentage replacements of the pozzolans, the beneficial effect on strength of the fine grinding of pumicite, and also indicated that when used in air-entrained mixes, the drying shrinkage of the concrete can be controlled satisfactorily. The reduction in early heat generation in concrete was also demonstrated.

The work has had its culmination in the letting of a contract for grinding Whirinaki diatomite, by micronising, preparatory to its use in the Atiamuri and Ohakuri hydro projects.

Cement work at Dominion Laboratory is aimed at knowledge of the setting and hardening processes of Portland cement, and at a better understanding of the chemical and physical nature of the products formed when pozzolans are incorporated in a concrete mix.

POLICE SCIENCE

For many years the Dominion Laboratory has given scientific assistance to the Police Department. A major aspect of this work is the qualitative and quantitative determination of poisons present in human organs in cases of deaths from poisoning. Over recent years the range of drugs and poisonous materials has greatly widened. The available methods for separation and identification of the barbiturate group have been inadequate, but the use of paper chromatography in such cases has proved of very great value. For example, the separation and identification of nembutal and amytal is now possible by this technique.

Additional work on the X-ray diffraction of a series of 18 barbiturates has shown that each can be identified by this method which, when sufficient material is available, will provide a valuable confirmation of the results obtained by chemical methods.

Work is being done to determine whether, in the case of poisoning by arsenic, the arsenic is evenly distributed in the liver.

In forensic chemistry investigations, numerous exhibits of paint, arson residues, body stains, tools, fibres, etc., have revealed useful information for the Police. A detailed study of glass fragments from various groups of objects has been undertaken to determine the variation of density and refractive index within and between articles and hence to assess the value of these determinations in proving the identity of two glass fragments. It was shown that 50 Lucas headlamp glasses could be distinguished from each other and that density and refractive index are constant over most single articles, with the exception of small sample bottles, in which there was a marked variation in density from point to point.

ELECTRON MICROSCOPY IN NEW ZEALAND

One of the original objectives of the Electron Microscope Section, when it was established at the Dominion Physical Laboratory in 1948, was the introduction of electron microscopy into research in New Zealand. Until now, one criterion for choosing subjects for the instrument has been the demonstration of electron microscopy to new people. This effort is now showing results. Numbers of people now realise that they need instruments themselves, and with the installation of new instruments at both the Medical School and the Dental School this year, the Dominion Physical Laboratory Electron Microscope Section should be able to devote more time to research.

The installation at Dominion Physical Laboratory of the Philips electron microscope in April 1958 will enable work of higher resolution to be carried out. Other facilities not available with the present instrument include electron diffraction, the ability to take stereo pairs, and higher contrasts on sectioned organic material.

The new instrument will be used for research in the following fields – fine structure of wool, meat, forest products including paper fillers, insect and plant virus, soils, etc. In these fields there is far more research waiting to be done than two instruments can handle. The future programme will be decided therefore only after a comprehensive survey.

The micro-structure of sheep's teeth is being determined in cooperation with Massey College. The excessive wear of teeth caused by improved pastures curtails the useful life of sheep, reduces the quantity of wool, and incurs financial loss to the farmers. Some progress has been made in this investigation and it is anticipated that certain sections of the work will provide additional knowledge on the structure of human teeth. Much of this research has been carried out with micrographs, with a magnification of 72,000.

FORCE MEASUREMENTS (METROLOGY)

There is no absolute standard for force as there could be for length (a length standard could well be the wavelength of light). The same "weight" (which is the standard of force) has the same mass in different parts of the world but, due to variations of gravity, the weight as registered by a sensitive spring balance is different. Establishing this sort of standard involves measuring gravity and is expensive and for this reason New Zealand accepts a secondary standard (an elastic proving device) which is calibrated on a dead-weight testing machine overseas.

With this secondary standard various testing machines are calibrated throughout the country for accuracy and it is intended, though not yet completely accomplishable, to be able to calibrate any testing machine to the degree of accuracy required by British Standard Specification 1610: Part 1: 1950.

The machines requiring testing are used for testing concrete pipes, concrete samples for dams, etc., chains from ships and hoisting gear, strengths of wood, paper, etc. They vary much, both in type and condition, and, in consequence, a degree of variety is also called for in the proving devices. Proving rings are particularly suitable for compression and tension testing machines of the platen type. Chain testing machines require something like a load-cell which is robust and portable although not quite so accurate. The grades to which these various machines are tested are—

Grade A—For precision testing. Maximum permissible error 0·5 per cent of applied load or 0·1 per cent of scale maximum, whichever is the greater.

Grade B—For commercial use. Maximum permissible error 1·5 per cent of the applied load or 0·3 per cent of scale maximum, whichever is the greater.

Grade C—For commercial use. Maximum permissible error 4 per cent of the applied load or 0·8 per cent of scale maximum, whichever is the greater.

NUCLEAR SCIENCE

Radiocarbon Dating—During the year 134 samples have been dated. Of these, 47 were for overseas laboratories, 35 for Government Departments, universities, and museums, and 52 for our own investigations. Further samples have been examined to follow the H-bomb effect. The ^{14}C specific activity of the atmosphere is at present 9 per cent above the 1954 value. The ^{14}C increase in surface ocean water, reported last year as being just detectable, has been substantiated. During December 1957 this increase amounted to 3 per cent. From such results it is possible to calculate an exchange time of 20 months for the transfer of carbon dioxide from the atmosphere to the ocean.

The possibilities of the radiocarbon method in the study of oceanography have been realised. Results published by American scientists for North Atlantic deep water gave 500 years as the turnover time for this ocean. We have examined an ocean profile from the New Caledonian Trench. The ^{14}C age of water at 1,500 metres was 1,500 years, while a sample of Antarctic deep water from 2,700 metres gave a ^{14}C age of 2,500 years. To obtain a wider range of surface and deep ocean water results, special extraction columns have been built for laboratory and shipboard conditions that enable the carbon dioxide to be removed from 40 gallons of water in one day.

Preliminary investigations indicate that the radiocarbon method can also be used to study the circulation time and the direction of underground water flow at Wairakei.

A theoretical study has been made of a possible way of extending the range of the ^{14}C dating equipment by isotopic enrichment using a thermal diffusion column. Construction of such a column may be

practicable but experimental determination of the CO_2 diffusion constants is necessary to validate this conclusion. The importance of electronic calculating machines for theoretical studies of the solution of physical-chemical problems is becoming more evident.

Mass Spectrometry—It has been possible to use the sulphur isotopic variations in the sulphide and sulphate of geothermal bore waters to estimate a temperature of 370 ± 70°c. for the hot chloride water underlying Wairakei. The mean sulphur isotopic ratio for sulphur discharging from fumaroles on White Island has shown that this sulphur is of magmatic origin. This evidence supports the possibility that the present isotopic ratio of sea-water sulphate is the result of bacterial fractionation. In developing the sulphur method, a study was made of the reactivity of graphite. It appears that graphite is extremely reactive at a temperature around 950°c. This work is being investigated further on account of the importance of graphite in atomic reactors.

Nitrogen uptake by the plants *Epilobium* and *Coprosma* has been further investigated to determine whether or not the fixation mechanism is in the root or foliage system.

A preliminary survey of carbon isotopic variations in the thermal areas showed that methane is 2 per cent enriched in the lighter isotope ^{12}C with respect to carbon dioxide - carbon. These results will enable confirmatory evidence to be obtained on the temperature of the underground heat source at Wairakei.

Radioactive Fall-out—Rainwater has been received monthly from six fall-out stations in New Zealand. Total beta-activity has been determined in the rainwater residues. Activities are higher in samples from high rainfall areas. It was possible to attribute activity in samples collected at Auckland and Havelock North over the period September–October 1957 to the explosion of nuclear devices in Australia during August–September 1957. The normal fall-out over New Zealand is stratospheric fall-out from H-bomb tests. A study has been made to separate ^{90}Strontium from the fall-out residues and to electroplate out its radioactive daughter ^{90}Yttrium. We have been asked by the United States Atomic Energy Commission to cooperate in estimating ^{90}Strontium, ^{140}Barium, and ^{137}Caesium in every rainfall at Gracefield in an endeavour to calculate the storage times of radioactive debris in the stratosphere. As specialised counting equipment is desirable, a plan has been suggested whereby America will supply equipment and this Division the manpower. Only two other laboratories in the world have undertaken these detailed measurements in order to settle questions of the temporal correlation of the tropospheric rise and fall and of the occurrence of tropospheric fall-out from bomb tests.

Metabolic Paths in Nature—An outstanding technique has been developed for studying metabolic paths in nature. Investigation of the photosynthetic cycle using ^{14}C has been pioneered in America by Dr C. A. Calvin. Little work has been done on the path of hydrogen in photo-synthesis or oxygen in respiration. Radioactive hydrogen (Tritium) in the form of water (T_20) could be used but no one has succeeded in making radioautographs with tritium. This is because the beta particles from tritium are so soft that when an extract of plant material is placed on filter paper, and the components separated

chromatographically, the beta particles from the tritium cannot penetrate through the paper to activate a photographic plate. This difficulty has been overcome by converting the beta particle energy to light quanta and photographing the light on a film. To do this, the paper chromatogram is soaked in toluene plus 0·2 per cent terphenyl. Radioautographs using tritium should prove very valuable in many fields of biochemical research.

MEDICAL INSTRUMENTATION

An automatic isodose recorder has been completed for use with the 4 Mev linear accelerator installed at the Auckland Hospital. Previously isodose curves have been produced either by distributing charged ionisation chambers in a water phantom or by plotting individual curves by means of a servo-positioned pen which is intended to follow a curve of constant dose rate traced by a search chamber in a water phantom. These methods are too time-consuming for use with the accelerator. A method has been devised in which the search chamber scans the phantom in a two-dimensional pattern. In the recording unit remote from the phantom a pen follows the same pattern by selsyn control, and as the search chamber moves through a dose rate gradient a servo motor drives a disc whose angular position is always related to the instantaneous dose rate. The disc carries detents corresponding to 10 per cent increments and these cause the pen to print. In the course of one scan, the pen may therefore print a dotted record of a whole set of isodose curves in one plane. Plotting time for a 15 × 15 cm. field is 15 minutes.

An experimental anaesthetic machine has been constructed to evaluate a positive-negative pressure breathing cycle in surgical cases with high venous pressure. Used earlier with animals the machine has now been employed on special human cases and the results have been very satisfactory. It will now be produced in a form suitable for routine theatre use.

A specially designed repeating pistol has been constructed for the implantation of radon seeds. Special cassettes are loaded by the X-ray laboratory and shipped in protective containers. The cassettes can be very simply transferred to the pistol, which delivers one seed at the tip of a large hypodermic needle for each operation of the trigger. It facilitates accurate control of the implantation and the method minimises the radiation hazard.

Further development of the recording ear oximeter has been carried out, and the instrumentation improved. Good agreement is being obtained with oxygen saturation values obtained from blood sampling and subsequent spectrographic analysis.

A simple and stable temperature recorder has been developed for body temperatures, particularly at the reduced level reached in hypothermia. The esophageal temperature has proved to be a more significant index than the previously recorded rectal temperature and special esophageal probes have been constructed.

A Beaver type respirator which is used in cases of complete respiratory paralysis has been considerably improved by the addition of a wick type humidifier as used on the automatic infant respirator and by

electrically heating the seat of the respiratory valve to eliminate condensation and the consequent sticking of the valve. The particular machine is in continuous use on a polio patient.

Modifications are being carried out to the Melrose type heart-lung machine recently installed in Auckland. These have included improvements to the oxygenator, reduction of pumping velocities to reduce foaming, and the addition of a venous reservoir.

An improved cardiotachometer has been built and is in routine use. It provides for greater freedom from artifacts, an automatic pulse amplitude control and a rate recording circuit having a greatly improved resolution, allowing an accurate record to be made of the short term effects of certain modern drugs.

The possibility of determining oxygen tension in tissue by a polarographic method has been rejected, but the requirement of determining the oxygenation of very young infants remains, and an alternative method is being considered.

INDUSTRIAL LIAISON AND INFORMATION

As a first step towards increasing the amount of scientific assistance that can be given in developing Auckland industry, a liaison and information service has been built up at the Auckland Industrial Development Laboratories.

The dissementation of information that will lead to improvement in methods, equipment, or materials must be based on a knowledge of the actual needs of the industry, and it is not sufficient only to arrange a fund of readily available information without first creating a favourable atmosphere for its reception.

During the past year the liaison engineer in charge of this work has visited a variety of industries, such visits arising from inquiries for information and tests of materials of construction. It has frequently been found that the nature of the problem has not been understood and it has been necessary to "live" with the firm for a period before the actual problem has been evaluated, and the way to a solution indicated.

During 1957 a series of lectures on advanced workshop technology were conducted at the Seddon Memorial Technical College for the benefit of senior apprentice trainees. A well attended symposium on laminated timber was held also in conjunction with the college.

In cooperation with the Hamilton Branch of the Auckland Manufacturers' Association, some progress has been made in commencing a liaison and information service at the Hamilton Technical College. It is hoped to set up a technical reference library, with a member of the college staff acting part-time as an industrial liaison officer.

The information section is closely associated with the "group" approach to industrial assistance, so as to obtain the maximum benefit from the work of a small staff. The section also arranges for the production of *Proceedings* for the Auckland Branch of the New Zealand Institute of Foundrymen, The Auckland Fuel Users' Research Group, and the Medical Instrumentation Group.

SOIL CORROSION

The corrosion of steel and concrete buried in soil has long been a serious engineering and economic problem. The high cost of underground structures and the inconvenience of repair makes even small

improvements in their life worthwhile. The corrosion of underground pipes costs about £1 per head per annum and about half of this would be due to external or soil corrosion.

Extensive field tests on buried metals have been carried out overseas, principally in the United States. In New Zealand in 1934 a Corrosion Committee, set up by the New Zealand Institution of Engineers, buried small mild steel test plates in several centres in the Dominion. In 1946 Soil Bureau officers assisted in estimating the degree to which these plates were corroded. Because the test plates were all in large towns the number of different types of soil was limited but this first survey, which included a number of sites on reclaimed flats, established, among other things, the importance of the bacteria *Vibrio desulphuricans* as a corrosive agent in New Zealand.

In 1951 further field tests, using mild steel plates, were put down and the work extended to cover a wide range of New Zealand soils. Two inspections, at two and a half years and six years, have already been made. These tests have shown that the most corrosive soils are acid clays and clay loams. In these the complete surface of the steel plates has been attacked and none of the original surface remained. The most outstanding feature is the pitting – large deep pits with rounded edges and sloping sides – due to the uneven contact of the plates with the cloddy backfill. Soils high in soluble salts are also highly corrosive but much of the original surface of the plates remained and the pits have undercut edges. In both these groups of soils the average rate of maximum penetration is of the same order, about 0·015 in. a year.

Waterlogged and slowly draining soils, whether acid or not, show low to moderate even attack without much pitting. The rate of average penetration is 0·001 in. a year.

Dry and sandy soils show only a low rate of attack and this attack consists of many shallow pits. The rate of average penetration is only 0·0004 in. a year.

In all but very wet soils the lower surface of the test plate has made poor contact with the soil and corrosion is very uneven, showing a smaller number of rather larger and deeper pits than the upper surface. The rate of average penetration has decreased with time in all except very wet soil.

During the war, steel was in short supply and wide use was made in New Zealand of cement asbestos and concrete pipes. Some of these have been examined for corrosion and the results published. In New Zealand the most important cause of soil corrosion of concrete and cement asbestos is probably ground water high in aggressive CO_2. In the most corrosive soil, softening to a depth of 0·12 in. occurred in six years and to a depth of 0·18 in. in 10 years. With a wall thickness of 1 in. this would give a life of at least 30 years. Thinner pipes might not allow a sufficient safety factor (especially if interior corrosion was also occurring) unless they were made of markedly more corrosion resistant material than those used. More field tests on concrete and cement asbestos are in progress at five wet sites.

NATIONAL PARK VEGETATION SURVEY

An arrangement has recently been made with the National Parks Authority for Botany Division to undertake vegetation surveys of the national parks. With one exception, such surveys have never previously been made. The exception is the Tongariro National Park where reports on the vegetation were made by Cockayne (1908) and Turner (1909), but both these classics are now out of print, and, in many respects, out of date.

Each survey will be published as a well illustrated bulletin, and will describe the vegetation units, give as complete a species list as possible, and describe the vegetation on certain permanent quadrats which will be marked out to record vegetation changes over the centuries.

Work has already begun at Mount Cook National Park, and by the 1959-60 season work will be in progress at Arthur's Pass and Mount Egmont.

These surveys are envisaged as part of a larger project with the aim of making contributions to a Botanical Survey of New Zealand.

ENTOMOLOGICAL RESEARCH

Grass Grub Control—Farmers who wish to apply DDT fertiliser mixes to control grass grub have been experiencing difficulties for some years now because of the uneven nature of dry mixes. Some bags contain all superphosphate and no DDT and some contain a great excess of DDT. Although better dry mixes are now available, the situation is still not satisfactory and the Entomology Division has been interested in other possible DDT fertiliser mixtures in which the DDT is more uniformly mixed.

Recently it has been possible, through the cooperation of the Fertiliser Manufacturers' Research Association, to have a preparation of superphosphate and DDT called a "wet-mix". The DDT is incorporated during the normal process of manufacture of superphosphate and tests have shown that it is evenly mixed throughout the mix. The finished product, however, is considerably coarser than the fine DDT particles employed in the dry mix. Tests against grass grub showed that the wet mix gives uniform results in killing but it is four to six weeks slower in action than are correctly prepared dry mix DDT-superphosphate preparations containing the particle size of DDT recommended by this Division. Because of this quicker action, these dry mixes containing fine DDT particles are recommended wherever average to high grub populations are present. Because of its more uniform nature, however, the wet mix is recommended for all other situations where a slower action can be tolerated (low grub populations, insurance against attack, laying down new pastures or lucerne crops, and for routine re-treatment).

Completion of surveys over a 12-year period of grass grub susceptible areas in North and South Islands and assessment of damage, showed that none of the land sown in introduced pastures and crops is absolutely free from grub attack, and as texture of soil was improved, the land became more liable to attack.

The survey over the 12-year period indicated also that grass grubs may be the main cause of weed encroachment on pasture lands and, if this can be substantiated, then the widespread use of weedkiller

followed by over- or under-sowing without first destroying grubs may not be the best way of dealing with this situation. Satisfactory control of grass grub in both North and South Islands has shown that DDT protected pastures do not become weed infested.

Manuka Blight—During the last three years a decline has been noticed in the effectiveness of the scale insect *Eriococcus orariensis* as a controlling factor on manuka in the northern Hawke's Bay area. The recovery of manuka is apparently due to the presence of a parasitic fungus capable of killing the scale insect which is responsible for manuka blight. Surveys have shown this parasitic fungus to be widely distributed in the hilly areas between Lake Waikaremoana and Gisborne, and that the fungus is also present at a number of isolated localities throughout the central areas of the North Island. Where the fungus can be observed macroscopically there is always an extremely low level of *E. orariensis* and manuka plants are making fresh growth. It is not known whether the fungus is a generalised parasite of scale insects in New Zealand or whether it is an accidental introduction specific to *E. orariensis*. A similar fungus is known to attack *Eriococcus* species on *Leptospermum* in Australia.

Insect Surveys—Last year an insect survey of agricultural crops in New Zealand was initiated. It is expected that data from this will ultimately allow us to assess fairly accurately the importance of each insect in the crop and should provide scientific data that will be basic to the work of this Division. In 1957, as a beginning, grasslands throughout the North Island were sampled. The pasture and roadside sampling stations numbered 113 and from this a great deal of insect material has been collected. The data secured has enabled the preparation of an account illustrating the general composition and complexity of the insect population of pastures in the North Island. This is the first known attempt at the study of such a complex over a reasonably extensive area. In addition, a great deal of information on the distribution and relative abundance of more than 270 species has been gathered. The work of identifying individual species continues with the aid of New Zealand and overseas specialists. Species new to science and previously undetected introductions from overseas are involved.

APHIS RESISTANT RAPE

Rape is used almost exclusively for fattening store lambs, and for economic utilisation it must be consumed *in situ* in the season in which it is grown. Between 150,000 and 200,000 acres are grown annually, and this fattens probably about 2 million lambs. About half the area is sown in Canterbury, the bulk of the remainder in Otago and Southland.

As with all annual forage crops, rape yields fluctuate considerably from year to year in response to rainfall variations, especially in the drier districts. The general effect of this is that in years when crops are good, grass production is also abundant and the rape crop is not needed; in dry years when grass growth is below average and the rape crop is most needed, it, too, is below average. Variability in yield from year to year is thus the main problem associated with this crop.

Plainly, these variations will always be with us, but variations in rape yield are accentuated by attacks of aphids – *Brevicoryne brassicae* – which in dry years often assume epidemic proportions over much of Canterbury and North Otago. An aphis resistant rape would therefore obviously be of value in these districts.

In 1948 work was begun on a project of breeding rape resistant to aphids. Club-root resistant rape was crossed with Calder swede, which is resistant to aphis attack. Since then, progeny testing and repeated selection for aphid resistance, combined with other desirable agronomic qualities, has been carried out. Selections highly resistant to aphis damage have been obtained. During the past season these resistant selections have been tested for yield and palatability to lambs in comparative trials with Broad Leaf Essex, the most commonly grown strain of rape. The season has been favourable for trials because aphid attack has not been sufficient to affect the productivity of the susceptible Broad Leaf Essex strain. In 12 trials – 10 in Canterbury, one in Otago, and one in Southland – the selections have been as productive, or more productive, than Broad Leaf Essex. They are at least as productive as this strain in the absence of aphid injury and still grow well under aphis infestation sufficient to destroy Broad Leaf Essex. In all trials they have been readily eaten by lambs.

At present the Crop Research Division has only a few ounces of seed of these selections. Given average seed yields, however, there should be enough seed on hand by 1960 to sow about 50,000 acres.

While the exact economic advantage of this rape is difficult to assess, there is no doubt that it will strengthen one of the weaker links in the meat production chain.

BRASSICA DISEASES AND PESTS

During the past few years attack by aphids and virus have caused extremely heavy losses in South Island brassica crops. From field surveys it has been difficult to determine the relative significance of aphids and virus diseases.

Field trials at the Plant Diseases Division during the past season have shown that under the dry conditions prevailing aphids alone or virus diseases alone could cause serious damage. Rape was severely damaged by aphids early in the season before any virus symptoms appeared in the field. York Globe and Green Globe turnips, though infected late in the season, showed considerable virus damage despite the absence of aphids breeding on these plants.

Early investigations in New Zealand indicated that the swede variety Sensation was resistant to virus infection, and later it was shown to be also resistant to the cabbage aphid. The New Zealand bred variety Calder, which has Sensation as one of its parents, is also resistant to virus infection and to attack by the cabbage aphid.

Results obtained from the above field trials show that a recently introduced swede variety, Doon Spartan, which has different agronomic characteristics, is comparable to Calder in resistance both to virus and to the cabbage aphid. They also indicate that the varieties resistant to cabbage aphid are not necessarily resistant to other aphids.

BLOAT

Bloat, or tympanites, is a disorder of cattle which occurs in all parts of the world where legume pastures are grazed, but probably causes more distress to the dairy farmer in New Zealand than to his counterpart in any other country. In the 1954–55 season, a Dairy Board survey showed a loss by death alone of some 15,000 cows valued at £300,000. The number of cows dying from bloat is by no means a measure of the full economic loss. It takes no account of the loss of milk production, both from the animals which die and those that recover, or of the loss of sheep and interference with farm routine experienced by the farmer.

Despite the fact that bloat has been experienced for a very long time, progress in elucidating its pathogenesis has been disappointingly slow. This has been largely due to the difficulty of reproducing the natural condition experimentally. In New Zealand we are "fortunate" in that pasture bloat can be produced experimentally in stall-fed animals, and this has enabled considerable progress to be made in determining the cause of the condition.

It has been found that the ailment is due to the trapping of gas, which is normally produced in the first two stomachs of ruminants, in a foam so that it is not free to be eliminated by eructation. Bloat is characterised by the sporadic nature of its occurrence and both animal and plant factors have been found to play a part. By no means all legume pastures cause bloat and some animals are more susceptible to the condition than are others.

Control measures evolved have included (a) the use of antifoaming agents to prevent foam formation; (b) the administration of low-level doses of antibiotics to slow down the initial gas production.

Research work into the fundamental cause of bloat has revealed that it is a very complex problem in plant-animal interactions. It involves a study of various aspects of animal physiology, microbial metabolism, and plant biochemistry.

Substances which contribute to the formation of a stable foam in the rumen are (a) the mucoproteins of the animal submaxillary saliva; (b) slime or gums formed by rumen bacteria (the formation of these is probably determined by the level of certain sugars in the clover); (c) proteins and saponins of the clover. Also the rapidity of gas formation in the rumen is dependent on the amount of readily fermentable substances present in the ingested herbage. An investigation of these aspects of the problems is being undertaken.

When all the factors involved in this complex ailment have been determined not only will our knowledge of various aspects of ruminant metabolism be increased, but it is hoped that improved control measures will result.

GRASSLAND RESEARCH

Plant Breeding—Notable in the plant breeding programme at Grasslands Division are the release to the farmer, through the certification scheme, of the new Grasslands strain of cocksfoot and also the selection of an improved strain of *Lotus uliginosus*.

The new cocksfoot has higher production, especially in winter and spring, than the previous New Zealand certified strains, without loss of palatability, summer persistence, or seed production. This new strain is being eagerly taken up by the trade, both in New Zealand and in

Britain, and it is likely that future demands for seed of this strain will be very high, especially in districts where short-rotation ryegrass suffers in the summer. The present commercial seed yields are, however, very low, largely through lack of adequate nitrogenous fertiliser, and it seems reasonable to propose that extra efforts should be made to ensure greater efficiency in cocksfoot seed production in this country.

A new selection of *Lotus uliginosus* is now under trial at Palmerston North and at substations. This strain is much more vigorous than those obtainable commercially but is still slow to establish from seed. It should prove valuable for hill country, swamp, and other difficult soil conditions. Work is at present under way to improve the winter productivity, using plant introductions from Portugal, which show promise for this character, and to improve the establishment, using a tetraploid form, induced at Grasslands by colchicine treatment. This new strain has seeds double the size of the normal strains.

Soil Fertility—Work continues at Grasslands on the soil fertility cycle and the various aspects of fertility increase under pasture, fertiliser, and the grazing animal; and the decrease under different forage and food crops. Experiments are being carried out under different conditions ranging from recent alluvial soils at Palmerston North to gumland at Kaikohe. At Palmerston North fertility was rapidly built up by good pasture; but also fertility rapidly declined under continuous cropping without fertilisers. For example, first crops of maize and kale following good pasture had an average yield of about 40 tons, whereas second crops yielded only 15 tons. Similarly with potatoes, first crops yielded about 18 tons, whereas the second crops were reduced to about 6 tons. The main nutrient concerned was nitrogen and this is, of course, associated with the organic matter in the soil. Similar studies are under way at Lincoln. On undeveloped gumland at Kaikohe, fertility building there commences at a low level with soil having poor physical condition, marked chemical deficiencies, and an inadequate population of bacteria capable of inoculating clovers. In between these extremes are other studies of different fertilisers, including artificial nitrogen effects, build-up and breakdown of organic matter in different soil types, and also the effects on soil structure and compaction by the treading of the grazing animal.

Pasture Seeds and Seedlings—In the establishment of a new pasture there is an early period when intense competition takes place among the seedlings. Many seedlings are suppressed and the composition of the pasture is largely determined at this stage. At Grasslands Division a study of seedling growth of pasture plants has been commenced with emphasis on factors important in competition between plants. It is believed that this will throw light on some problems of pasture establishment. Seed dormancy in pasture grasses and clovers is also being studied. It is known that the seeds of many plants lie dormant in the soil for some time before germinating. This characteristic obviously has survival value for it is possessed in a high degree by many of our most persistent weeds. The information being gathered should help to indicate how best to encourage natural regeneration of good grasses, how to combat weed grasses, and prevent contamination of pedigree seed crops. For example, preliminary data suggest that the seed of barley grass, a difficult weed of high-production pastures, remains viable in the soil for only a few

months – thus control of this grass should be more readily achieved than control of species such as ratstail grass, the seed of which persists for much longer.

DEATH OF PINES

Over a period of many years there has been a history of periodic tree death in shelter belts throughout New Zealand but particularly in the North Island. The trees affected are *Pinus radiata, Pinus muricata, Cupressus macrocarpa, Chamaecyparis lawsoniana.* It has been observed that high mortality of trees usually follows wet winters, but the cause has defied detection.

Recent work by the Plant Diseases Division has shown that the death of pines in shelter belts is associated with the presence of *Phytophthora* species in the soil. Three species of *Phytophthora* have been isolated from soils in the vicinity of diseased trees and all have been shown to be pathogenic to pine tree rootlets. Examination of root systems of infected trees has shown that attack by these fungi is practically confined to rootlets.

The disease situation is a complex one. Infection of rootlets is favoured by high soil moisture and under these conditions many rootlets are killed. New rootlets are formed to replace those killed and if soil moisture becomes less, trees recover. If, however, soil moisture remains high, more and more rootlets are killed, and when transpiration becomes high with the onset of warm weather, trees die from physiological drought brought about by lack of rootlets. In free-draining soil or in situations where slope of land allows water to drain away rapidly, trees do not die following wet winters although *Phytophthora* is present in the soil.

There is also a high mortality of trees in some of New Zealand's pine forests. The picture there is not so clear as in shelter belts since competition is also a factor in tree death. However, investigations have shown that in areas where mortality is high *Phytophthora* species are present in the soil. There is little doubt that these *Phytophthora* species have been present in the forest soils for many years. Nevertheless, records from some areas where mortality has been serious show that there is still an annual increase in average wood volume per acre. Therefore, it would appear that while there is no likelihood of any widespread catastrophic loss, any measures which would reduce mortality would be of high economic significance.

With increased knowledge of pine death and its cause it will be possible to plan hedgerow and forest planting using non-susceptible tree species. It may also be possible to reduce losses through selection and breeding for resistance.

In connection with this investigation the Auckland Industrial Development Laboratories have developed a method of measuring sap flow by means of heat transport. An instantaneous line pulse of heat is released in the sapwood by passing an electric current through a resistance wire (perpendicular to the sap streams) and the resulting temperature changes at a point about $\frac{1}{2}$ in downstream are measured by means of a thermistor probe. Fortunately the homogeneous nature of the xylem of conifers like *Pinus radiata* (the tree in question) lends itself to a mathematical prediction of these temperature changes in terms of the physical properties of the wood and the rate of sap flow and, conversely, the sap flow and other

properties can be deduced from an analysis of the temperature changes. Experiments confirmed the theoretical predictions and showed that the instrument will be a very useful tool in sap flow research.

PHOSPHORUS IN NEW ZEALAND SOILS

Because of the necessity of conserving the relatively cheap supplies of rock phosphate from Nauru and Ocean Islands, it is becoming increasingly important to improve the utilisation of the phosphate applied to our soils. Of the million tons of phosphate fertiliser used annually, only a fraction of it can actually be used by the plant. The remainder, 800,000 to 900,000 tons, is locked up in the soil by phosphate fixation in forms not readily available to plants.

An approach to this problem has been made by the Soil Bureau with a survey of phosphorus in New Zealand soils. This survey has indicated the factors which determine the amount and nature of phosphorus in the soils, which in turn has allowed a better understanding of their phosphate fertiliser requirements. The investigation has included an evaluation of the relative levels of plant-available phosphorus using the phosphorus content of the grass sweet vernal (*Anthroxanthum odoratum*) and the fractionation of the total soil phosphorus into organic phosphorus, inorganic phosphorus, and an estimation of inorganic phosphorus unavailable to plants.

The phosphorus levels in plant and soil have been related to the Soil Bureau's genetic classification of New Zealand soils and this has shown how these phosphorus values are affected by the processes operating in New Zealand soils. The level of soil phosphorus is first determined by the level of phosphorus in the parent material of the soil. For example, the soils from basic volcanic ash around Mt. Egmont have a phosphorus content of about 0·25 per cent P., a figure much higher than that of the comparable pumice soils of the central plateau, 0·07 per cent P., which are formed from an acidic volcanic ash.

On each parent material, as the soils have developed under the influence of weathering and leaching, phosphorus has been lost from the topsoil. The total soil phosphorus content of the weakly weathered and weakly leached soils from greywacke in Central Otago is about 0·12 per cent P., but the value for a strongly weathered and strongly leached yellow brown earth soil from greywacke in North Auckland is low, 0·04 per cent P. Podsolisation of these yellow brown earths reduces the total phosphorus figure to 0·01 per cent. Accompanying this loss of phosphorus, as the soils develop, provided that the products of weathering, notably iron and aluminium, are not extensively lost, an increasing proportion of the remaining inorganic phosphorus becomes unavailable for plants. When iron and aluminium are extensively lost, under the influence of podsolisation, this trend is reversed and the inorganic phosphorus, though present in very small amounts, becomes increasingly available.

These trends in the relative levels of available phosphorus were confirmed by the phosphorus content of the sweet vernal grass and they agree with the fertiliser needs of the soils. The highest plant phosphorus values were obtained from the youngest soils, the recent soils from alluvium and volcanic ash and from the weakly weathered soils of the South Island developed on loess deposits. These soils have the lowest requirements of phosphate fertiliser. The lowest plant phosphorus values

were obtaned from the strongly weathered and strongly leached ironstone soils and from some peat soils. These low values illustrate the two main forms of phosphate fixation occurring in New Zealand soils, the first in inorganic form and the second in organic form.

This survey has served to show the dominating influence of soil processes in determining the phosphate fertiliser requirements of our soils. It gives a factual basis for studying the phenomenon of phosphate fixation and for finding methods of obtaining better utilisation of phosphate fertiliser.

LAND UTILISATION IN THE OTAGO LAND DISTRICT

One of the most important applications of reconnaissance soil surveys is in helping to plan future land development. The general soil survey of the South Island, on a scale of 4 miles to the inch, provides a basis for the assessment of the present utilisation and of possible land development. As an earnest of what can be done, a map has been made of the Otago Land District, an area of some 8½ million acres.

The natural fertility of the soils, slope, altitude, texture, moisture status, and natural vegetation are recognised in the construction of a soil map. Consequently, by grouping these relevant factors a land use map can be made and from this the possibilities of development can be gauged. It is not the province of soil surveys to weigh fully economic considerations and, consequently, any land use map must be wedded to economic factors before development proceeds. With this limitation in mind the soils of Otago Land District can be broadly classified as follows:

(1) Soils of slightly more than half of the district (4,400,000 acres) are unsuitable for pastoral farming because of very low fertility or liability to serious erosion under grazing. These soils should be protected by a dense vegetation (e.g., tussock or forest) although 800,000 acres of hilly lands bordering the downlands may be used for timber production.

(2) Only about 8 per cent (or 680,000 acres) of the district has soils capable of intensive use. These soils occur mainly on the Taieri Plains and on the lower rainfall downlands of the Oamaru, Balclutha, and Tapanui districts. 100,000 acres of this class are suitable for intensive cropping.

(3) Soils of about 15 per cent (1,400,000 acres) of the district are of moderate to low production at present, but can be developed into moderate to highly productive pastoral lands by known methods of management. These soils comprise the rolling and hilly lands of moderate rainfall and altitude such as occur along the coast north and south of Dunedin and west of Palmerston and the Taieri Plains.

(4) Soils of 25 per cent (2,100,000 acres) of the district are low producing at present and capable of only small improvement. These are mainly the soils of inland basins where soil moisture is deficient and the surfaces too stony or broken for cultivation and irrigation.

FRUIT RESEARCH

Forecasting Storage Quality of Apples—Australian workers have shown that, in some of their apple varieties, good keeping quality is associated with relatively small cells in the apple flesh. If this were found to apply to our apples it should be possible to forecast keeping quality, an immense gain to the whole industry. Two years ago the Fruit Research

Division started measuring cell size in Sturmer apples that had received different fertiliser treatments. Those lines known to store well were found to have smaller cells than other lots known to break down quickly. Thus we seem to have a possible method of forecasting storage quality, but in its original form it is too slow for practical application. To measure cell size in a given line of fruit, sections are cut by hand from each of 20 apples, and 20 cells in each section measured under a microscope.

A considerable improvement has been made by the discovery of a method to separate apple cells without altering their shape or size. This is achieved by dissolving away the material that holds cells together, and once separated, cells are relatively easy to measure. Elimination of section cutting has allowed experimental work to be pushed ahead rapidly, and we are approaching the time when it will be possible to attempt commercial forecasting of apple storage quality.

Nitrogen in Fruit Trees—It has been known for some time that many New Zealand orchards are deficient in nitrogen, but there is no quick method of determining how much nitrogenous fertiliser should be applied to correct this deficiency. As field trials showed no signs of providing an answer to this problem, a basic study of the role of nitrogen in fruit trees was undertaken by the Fruit Research Division. First results of this investigation have now been reported, and they have added considerably to our knowledge of the way in which a tree uses nitrogen.

Before any effective work could be undertaken it was necessary to devise an improved method of extracting sap from woody shoots. This was achieved and shown to be applicable to a wide range of plants. It was then found that one old theory was wrong. Inorganic nitrogen salts are not transported unchanged from roots to leaves. Somewhere in tree roots nitrogen is converted from inorganic to organic forms. These are forms which leaves can use immediately to build up the proteins essential for life and growth.

Another old theory has been confirmed. Good evidence was obtained that a substantial portion at least of the nitrogen reaching the leaves must move upwards through the xylem.

Xylem saps from 131 different species of plants were examined for nitrogen content. Whatever nitrogen compound predominated there was always a range of amino acids present. These showed a striking similarity through the range of species examined, suggesting a uniform method of incorporating nitrogen into organic forms throughout a large group of plants. However, the presence in some species of relatively large amounts of citrulline and the ureides indicates that striking differences also occur.

Apple Variety Collection—By a process of trial and error, New Zealand fruitgrowers have selected a range of apple varieties of proven economic worth. There are several good midseason varieties to choose from but we lack well-coloured apples of high quality earlier than Gravenstein and later than Delicious. Some growers are always willing to try new varieties, but it is a slow, haphazard process for the individual.

Some years ago the Fruit Research Division embarked on an intensive search for suitable varieties to fill these gaps. Research stations in every major apple-growing country of the world cooperated by supplying budwood of their best commercial apples, together with new varieties they considered promising. These varieties and all the likely local seedlings that have been reported were worked on dwarfing rootstocks, and planted in one block at Havelock North. There is now a comprehensive

collection growing under conditions designed to permit rapid selection. A full crop was borne by most trees in the variety block this season and some preliminary assessments have been made. Unfortunately, none of the early apples has proved as good as Gravenstein, but prospects for good, late varieties are better. As soon as any outstanding varieties have been selected a limited number of trees will be propagated and supplied to growers for trial in all apple-growing districts.

Plum Variety Descriptions—Most of the plums grown in New Zealand are of Japanese type, but no satisfactory descriptions are available for many varieties within this group. This has led to a degree of confusion at all stages of plum growing, for without good descriptions varieties cannot be identified. To meet this basic need of the stone fruit industry, the Fruit Research Division has started to sort out some 60 varieties of Japanese plums. This is done by determining which features are characteristic for each variety, then describing these in detail, and indicating how each differs from similar plums. Points of difference are found in leaves, shoots, flowers, fruit, stones, and general growth habit.

TOBACCO RESEARCH

A plentiful supply of healthy transplants is the first requirement for a successful tobacco crop. Two problems confront the grower, the control of weeds in the seedling bed and the control of diseases which originate in the beds and can be carried out to the field. For the control of weeds, methyl bromide gas, introduced by the Tobacco Research Station, has proved very satisfactory and is used by up to fifty per cent of the growers. While methyl bromide is relatively simple to apply, it does require some equipment and some growers are not easy about the risks associated with the storage and handling of a poisonous material. Other chemicals are constantly being tested with steam and methyl bromide as controls. Two of these, Vapam and allyl alcohol show promise. They are simple to apply, the concentrated material being diluted with a large volume of water and applied through a watering can. Vapam has given excellent control of weeds but has to be used at least four weeks before the seed is sown to allow the toxic effects to dissipate. Allyl alcohol, although not quite so effective in the control of weeds, has the advantage of requiring only 10 days between treatment and sowing.

The chief diseases which concern the grower at this stage are various forms of stem rot or collar rot. These can originate in the seedling bed and are carried to the field on the transplants, many of which die, requiring considerable replanting. Applying a drench of ferbam or thiram to the seedling beds resulted in excellent control of both types of stem rot.

It has long been realised that the conventional method of flue-curing tobacco resulted in very inefficient utilisation of the heat supplied, and also left much to be desired in the degree of control of temperature and humidity in the kiln. Several years ago officers of the Dominion Laboratory, working with the Tobacco Research Station, developed a new type of kiln. In this, the air was preheated in a separate chamber, introduced into the top of the kiln, and moved downward by fans. This has resulted in a much more uniform cure, more positive control of temperature and humidity within the kiln, a reduction of the curing period and a saving of fuel. Now over 100 kilns employ the downdraught principle, representing about one-fifth of the total kilns in use.

BLOTCHY RIPENING OF TOMATOES

For many years blotchy ripening, a physiological disorder of tomatoes, has caused serious losses of glasshouse tomato crops, both in New Zealand and other countries. The effect of the disease is to produce light-coloured blotches on ripe fruit. When blotching is slight, fruit is down graded, and when severe, it is unmarketable. In individual pickings losses through blotchy ripening may be as high as 90 per cent. Although many workers have investigated the problem and some have shown that changes in cultural practices may have some influence on development of the disease, the primary cause has remained undetermined.

Investigations carried out by an officer of the Soil Bureau stationed at Cawthron Institute, using plastic covers, suggested that shade and high humidity were factors in the development of blotchy ripening. During the past season work at the Plant Diseases Division has shown conclusively that under commercial glasshouse conditions high atmospheric humidity for a period of several days may lead to a high incidence of blotchy ripening, and that high levels of watering increase the effect of high humidity. Tomato plants have been subjected to various closely-controlled environments in plant cabinets at the Dominion Physical Laboratory during the ripening period. Preliminary results indicate that the critical stage of fruit development is when the fruit is fully developed and just beginning to ripen. The affected fruit is ready for picking five to 20 days after the plant has been subjected to the unfavourable environment. Low light intensity during the critical period of ripening increases the incidence of infection. A fuller understanding of this should enable remedial action to be taken with commercial crops.

RABBIT STUDIES AND SURVEYS

Age has an important influence on the reproductive potential and parasite burden of rabbits, and knowledge of the age structure of a population is useful in estimating its rate of increase and in assessing the effects of control measures. It has been found that rabbits can be aged by their weight only up to about four months, by which age they are full grown and already sexually mature. However, investigations carried out by the Animal Ecology Section show that rabbits up to nine and a half months of age can be recognised by the presence of a cartilage between the epiphysis and head of the tibia; this cartilage is completely replaced by bone in older rabbits. Current work on age determination of rabbits more than nine and a half months old according to the degree of fusion of the epiphyses of the lumbar vertebrae now makes it possible to recognise rabbits up to two and a half years old. This has already proved useful in assessing the age structure of rabbit populations involved in several ecological investigations.

Observations have been made on the rate at which rabbits recolonise an area, following complete destruction of the population. In late winter 1955, after a population of 265 rabbits (11 to an acre) had been completely cleared up from a 24-acre rabbit-proof enclosure, openings were made in the fence to admit rabbits living in the surrounding country. From this time rabbit control was continued outside the enclosure, while the rabbits inside the enclosure were allowed to increase without interference. A year later, in the winter of 1956, there were some 15–20 rabbits in the enclosure; and in winter 1957, when the openings in the fence were closed, about 30–35 rabbits. Finally, in

January 1958, three breeding seasons since the beginning of recolonisation, the population in the enclosure was about 70–80 rabbits; at about three rabbits to the acre. This is slightly above the density outside the enclosure where rabbits had been controlled. These observations confirm that although neighbouring populations of rabbits will quickly recolonise a depopulated area in country favourable to rabbits, their initial rate of increase is rather slow.

A joint expedition (Animal Ecology Section, New Zealand Forest Service and Auckland Institute and Museum) to Lake Monk, in the Cameron Mountains of Southern Fiordland, carried out a survey of the deer, small mammals, and birds, and their relation to the native vegetation, and gave special attention to the changes resulting from deer grazing. This was particularly valuable in demonstrating what can happen in areas completely free from any human activity.

Overseas work has shown the vulnerability of man-made forests to sudden attacks of insect pests and the importance of insectivorous birds in preventing serious outbreaks. Nothing is known about the important relationship between bird and insect populations in New Zealand's exotic forests; and it is proposed to initiate some work on this subject with the cooperation of the New Zealand Forest Service.

INFORMATION BUREAU

The work of the Information Bureau includes the editing and publishing of departmental publications, and the maintenance of the Central Library, Technical Information Section, Translations, Public Relations Office, and Photographic and Photocopy Section.

The first issues of the three new journals (which replaced the *New Zealand Journal of Science and Technology*) have been published – the *New Zealand Journal of Agricultural Research* and the *New Zealand Journal of Geology and Geophysics* in February, and the *New Zealand Journal of Science* in March, 1958. The first named will be published in alternate months, and the other two quarterly. The policy regarding material to be published remains as before, i.e., articles are required to be based on original scientific work carried out in New Zealand, or on New Zealand material, or, in special cases, to have some other connection with New Zealand. The field covers practically all branches of pure and applied science.

During the past year the Bureau has, in addition, edited and published 20 bulletins and other publications on behalf of branches of the Department.

The Technical Information Section dealt with some 600 important inquiries during the year. Almost half of these were from manufacturers, and about one-third were from Government Departments and local authorities. Over 30 letters of appreciation showed that the service given was of value. The Technical Information Officer keeps in close touch with scientific officers, and with the Scientific Liaison Offices in London and Washington. Collaboration with overseas information agencies has been further extended. As a result of international collaboration an increasing amount of valuable literature has become available to New Zealand, e.g., several hundred technical pamphlets of the United States International Cooperation Administration.

The *Industrial Bulletin* is published jointly by this Department and the Department of Industries and Commerce. Approximately 250 abstracts and scientific and technical articles were contributed to it during the year by the Technical Information Section. Almost 170 requests were subsequently received for further information on the subjects referred to.

SCIENTIFIC LIAISON SERVICE

The Department's Scientific Liaison Offices in London and Washington are responsible for keeping New Zealand research workers advised of the most recent, relevant, and important scientific work being carried out overseas. The receipt of this information, much of which would not be available through normal channels, assists the Department and its officers in formulating and modifying research programmes.

The Senior Scientific Liaison Officer in London, in addition to other duties, gives oversight, in the United Kingdom, to members of the New Zealand Defence Scientific Corps, and to New Zealand National Research Fellows, represents New Zealand on a number of Commonwealth scientific committees, and acts in an advisory capacity in scientific matters to the High Commissioner's Office.

In both London and Washington the Department's representatives are associated with liaison officers from other Commonwealth countries in a British Commonwealth Scientific Office (B.C.S.O.). This association has been of outstanding benefit to the officers concerned and to the Department and has been an important factor in facilitating Commonwealth cooperation in scientific matters.

The Department greatly appreciates the assistance given to its liaison staff by overseas research organisations.

CONCLUSION

The Department has continued to receive generous cooperation from other State Departments, the Cawthron Institute, and the university colleges, overseas scientific organisations, and from both farming and manufacturing interests. The good relations that have prevailed have been much appreciated and have greatly assisted the promotion of the Department's objectives.

In conclusion, I would thank the staff of the Department for their help and cooperation during the year, and also express my personal indebtedness to the Council of Scientific and Industrial Research and its advisory committees for the assistance they have generously rendered on all occasions.

W. M. Hamilton, Secretary.

BRANCHES

ANIMAL ECOLOGY SECTION

Officer in Charge: Dr K. Wodzicki

PROJECTS

Research on Mammals

Rabbits—Long-term investigation of rabbit breeding; factors affecting the population density of rabbits, with particular reference to the Wairarapa; census techniques; geographic distribution of rabbit nematodes in the North Island; incidence of coccidial and helminth parasites in Hawke's Bay rabbits; age determination by the sequence of bone fusion; studies for a history of the rabbit in New Zealand; and investigation into baits for rabbits.

Rats—Study of rat populations in native forests; and rat - wild cat - petrel relationships on Little Barrier Island.

Hedgehogs—Investigations into food, movements, and population structure in different habitats.

Research on Birds

Effect of control measures on the rook populations of Canterbury and Hawke's Bay; and the role of native and introduced birds in the natural control of insect populations in exotic forests.

Surveys

Effect of land development on bird and mammal populations in Western Taupo.

PUBLICATIONS

The Hedgehog Population and Invertebrate Fauna of the West Coast Sand Dunes. *Proc. N.Z. Ecol. Soc. 5*:27–29. R. E. Brockie.

Distribution and Abundance of the Rook *(Corvus frugilegus L.)* in New Zealand. *Nortornis 7, 5*:137–161. P. C. Bull.

Changing Incidence of Parasites in a Declining Rabbit Population. *Proc. N.Z. Ecol. Soc. 5*:11–12. P. C. Bull.

A Device for Holding Rabbits During X-ray Photography. *J. Wildlife Mgt. 21, 4*:453–454. R. L. Edgar.

Ecology of Rabbits in New Zealand Compared with California Rodents. *Proc. N.Z. Ecol. Soc. 5*:13–14. Walter E. Howard.

APPLIED MATHEMATICS LABORATORY

Director: Dr R. M. Williams

PROJECTS

Work on boiler efficiency, firing of brick kilns, cracking of bricks in drying, calculation of underground temperatures from surface temperatures, flow of heated viscous liquids through porous media (for geothermal project), draining of soils, clay consolidation, spontaneous ignition of wool, ionospheric problems, flow in pipes, prediction of satellite orbits, propulsion of bull spermatozoa and mathematical

genetics; estimation of variance components; various developments in design and analysis of experiments; use of covariance analysis in heavy clay industry; study of plant distribution patterns; study of airline reservation control; design of methods for bacteriological testing; discriminant function analyses of New Zealand soils; rhizopod bacteria competition; examination of Markov chain theory for comparison of teaching periods in educational research; an analysis of catchment data; treatment of virus counts and virus antibody reactions; development of time series analysis; and machine calculations for Geophysical Observatory, Department of Agriculture, and others.

Design and Analysis of Surveys and Experiments in a Variety of Fields—These include numerous experiments in grasslands research, microclimatic work of grasslands, use of fertiliser, ram tupping and lamb survey figures for the New Zealand Wool Board, data from Entolomogy Division, tobacco trials, phosphate trials, cheese trials, fluoridation survey, dental caries, maternity data, data on chest diseases, I.G.Y. data, ecological data, educational research, brick manufacture, commercial cleaning, and data from Police Department.

PUBLICATIONS

Difference Between Consecutive Members of a Series of Random Variables Arranged in Order of Size. *Biometrika 44*:211–8. J. H. Darwin.

The Power of the Poisson Index of Dispersion. *Ibid. 44*:286–9. J. H. Darwin.

The Uses of Sampling Techniques in Auditing. *The Accountants' Journal 35*:382–4. J. H. Darwin, H. S. Roberts, and R. M. Williams.

Goitrogenic Effect of White Clover, II. *N.Z. J. Sci. Tech. A38*:793–802. A. Glenday (with Butler, Flux, Petersen, Wright and Johnson).

Interaction, Heterosis and Diallel Crosses. *Genetics 42*:336–355. B. I. Hayman.

The Effectiveness of a Tetradecylamine Dental Cream in Reducing Dental Caries. *N.Z. Dental Journal 53*:63–67. W. B. Taylor (with T. G. Ludwig).

Some Combinatorial Results for Matrix Powers. *Quarterly Journal of Mathematics 7*:316–20. P. Whittle.

Curve and Periodogram Smoothing. *J. Roy. Stat. Soc. B19*:38–47. P. Whittle.

On the Use of the Normal Approximation in the Treatment of Stochastic Processes. *Ibid. 19*:268–81. P. Whittle.

On the Variation of Yield Variance with Plot Size. *Biometrika 43*:337–43. P. Whittle.

A Model Explaining the Pareto Distribution of Wealth. *Econometrica 25*:591–5. P. Whittle (with H. Wold).

Steady State Free Thermal Convection of Liquid in a Saturated Permeable Medium. *J. Fluid Mechanics 2*:273–285. R. A. Wooding.

AUCKLAND INDUSTRIAL DEVELOPMENT LABORATORIES

Director: Mr J. B. Brooke

PROJECTS

Physics Section—Physical aspects of air pollution in Auckland; assistance to Health Department in the use of Ringelmann charts; assistance to local bodies in draughting anti-pollution regulations; grit sampling in boiler stacks of freezing works; physical testing of manufacturers' instruments and components; metrology, including dies, tools, and manufactured components; testing of P.V.C. cable to standard specification; and the measurement of sap flow in trees.

Medical Instrumentation—Completion and testing of the automatic isodose recorder for use with 4 Mev accelerator; experimental blood coagulation timer; modifications and application of recording ear oximeter; modification to Beaver respirator, humidifier and inspiratory valve; development of radon seed applicator; design and construction of closed-circuit animal-breathing apparatus; further development of high resolution cardiotachometer; construction of esophageal temperature recorder; continuing development of instrumentation for bloat investigation; construction of soap film flow integrator; modifications to heart-lung machine; investigation of method of tissue oxygen measurement; construction of windowless Geiger counter chamber; advice on development of adult polio machine; and investigation of control of infant oxygen therapy.

Design and Workshop Sections

Medical—Design and construction of X-ray isodose recorder; radon gun for injection of seeds in urology operations; additional components and modifications to Melrose heart-lung machine (venous reservoir, depulsator); soap film flowmeter for infants' breathing volumes; negative pressure units for neurosurgical department (Dunedin Hospital); cephalometer for X-ray examination of teeth; oxygen humidifier for polio patients; rectal thermistor probes for temperature recorder; oximeter earpiece; infant non-rebreathing valve with Teflon valves; bloat transducers; defibrillator; and foot rest and manipulator.

Fuel Group—Sawdust cyclone investigations; grit sampling equipment for industrial stacks; crucible swelling furnaces; orifice plate carriers; ventilation system; and flowmeter equipment.

Foundry Group—Experimental foundry equipment; and design of cupola for experimental foundry.

General Industrial—Oval bottle label production system; finned heat-exchange-tube machine; newsprint reel clamp and wrapping paper tests; spark chronograph; windowless three-station Geiger counter; resistance thermometers for Ministry of Works dam projects; cistern valve investigations; anti-hunt mechanism for control of plant humidity units; water flow integrator; sea current recorder investigations; vee belt drive efficiency investigations; large crane bearing investigation; tests on high speed dental drills; and bathythermograph calibration rig.

Balancing, Vibration Analysis, and Strain Gauge Work in Industry—Dynamic balancing of ship oil purifiers, truck drive-shafts, brush rolls for softboard mill, ventilation fan at a departmental store, and rolls at

Kinleith pulp and paper mills; vibration investigation in bearings of papermaking machine at Kawerau; strain gauge applications at Maraetai dam, checking design of control links and in evaluation of prestressed roadways; and general instrument and engraving work.

Metallurgy Section

Foundry Technology, Foundry Sands and Clays—Surveys completed of Auckland and Christchurch foundry sands; investigation of foundry properties of New Zealand bentonite and other clays; and survey of New Zealand foundry practice.

General Metallurgy—Examination of failed machine components; and investigation of corrosion of hulls and marine equipment, and structural steelwork.

Mechanical Testing—Mechanical testing to standard specification requirements of metals and other materials such as cords, ropes, wire ropes, chains, roofing tiles, corrugated asbestos, etc.

Non-destructive Testing—Magnetic crack testing of vehicle components, and gamma ray inspection of welded structures.

PUBLICATION

An Improved Negative Pressure System for Reduction of Cerebral Blood Pressure in Neurosurgery. *Journal of Neurosurgery 14*:6, 695–699. B. H. Hodder.

BOTANY DIVISION

Director: Dr E. J. Godley

PROJECTS

Herbarium—Maintenance and expansion of the herbarium of indigenous, adventive, and cultivated plants and seeds; collection and distribution of seeds of indigenous plants, and annual issue of an *Index Seminum.*

Botanic Garden—Establishment at Lincoln of a botanic garden for the conduct of the Division's observations and experimental work, and for maintenance of a reference collection of growing plant material.

Taxonomic Studies—Completion of Volume 1 of the revised *Manual of N.Z. Flora;* preparation of material for Volume 2 (Monocotyledons); preparation of a *Flora of Adventive Plants in N.Z.*; and preparation of a monograph of the N.Z. grasses.

Chromosome Studies—Preparation of chromosome atlas of New Zealand indigenous plants, with present emphasis on the grasses; and completion of studies of chromosome behaviour in New Zealand Gymnosperms and woody Violaceae.

Vegetation Studies—Vegetation surveys of National Parks, as part of contributions to a botanical survey of New Zealand; ecological observations on higher altitude native grasslands; and study of New Zealand freshwater plants and their distribution.

Quarternary History—Pollen analysis of Antipodes and Chatham Islands peat profiles; pollen and macrofossil analysis of local peats; pollen morphology of native Podocarpaceae and Umbelliferae; and expansion of reference collection of pollen.

PUBLICATIONS

Breeding Systems in some New Zealand Grasses. *N.Z. J. Sci. Tech. A38*: 743–751. H. E. Connor.

Agropyron x wallii, A Natural Hybrid in New Zealand. *Trans. Royal Soc. N.Z. 84*:757–60. H. E. Connor.

Contributions to a Knowledge of the Adventive Flora of New Zealand, No. 5. *Ibid. 84*:649–59. A. J. Healy.

Mediterranean Mustard, a New and Potentially Troublesome Weed in New Zealand. *N.Z. J. Agric. 96*:111–113. A. J. Healy.

The Species of *Xeronema* (Liliaceae). *Pacific Science 11*:355–62. L. B. Moore.

A Numerical Study of the Distribution of Grasses in New Zealand. *Proc. N.Z. Ecol. Soc. 4*:9–10. V. D. Zotov.

Index Seminum, Anno MCMLVII Collectorum.

CROP RESEARCH DIVISION

Director: Dr L. Corkill

FIELD-CROP PROJECTS

Wheat Breeding—A general-purpose wheat similar to Aotea in yield but with higher baking quality; an early-maturing variety that will not lodge, to replace Tainui and Gabo in the North Island; a high-yielding wheat with better baking quality to replace Arawa on high-fertility land; a high-quality wheat like Hilgendorf with greater yield; lines of commercial varieties resistant to mildew; drought resistant wheats for light land; and lines resistant to cereal yellow-dwarf virus.

Wheat Genetics—Inheritance of kernel weight, grain-shattering, protein, mildew resistance, purple grain colour, and production of supernumerary grains.

Oat Breeding—Lodging resistant milling oats; lines of commercial varieties resistant to crownrust; and introduction and testing of overseas varieties.

Oat Genetics—Inheritance of hull type and seedling chlorosis.

Barley—Introduction and testing of new overseas varieties.

Potato Breeding—Resistance to blight (*Phytophthora infestans*), scab, and pink rot (*P. erythroseptica*); resistance to viruses X, Y, and leafroll; and improved agronomic characters.

Virus-free Stocks of Potatoes—Selection of virus-free plants of commercial varieties and maintenance of nucleus stocks; and annual testing of virus-free stocks that are being increased by the Department of Agriculture.

Potato Virus Diseases—Study of the natural spread of virus diseases; study of strains of viruses X and Y; methods of eliminating virus from infected stocks; methods of testing for virus content and virus resistance; study of the nature of resistance and of gene action and the effect of environment upon resistance; and study of potato aphid populations in Canterbury throughout the growing season.

Potato Blight—Study of blight strains in New Zealand and of their origin; study of the nature of resistance and of gene action; and the effect of environment upon resistance.

Agronomy—Effect of irrigation and other agronomic practices upon potato yields.

Swede Breeding—Resistance to dry rot and club root.

Swede Gentics—Inheritance of split cotyledon and split petals.

Rape Breeding—Resistance to aphids.

Turnips—Searching for resistance to cauliflower mosaic and breeding for club-root resistant green globe type.

Cabbage Aphids—Population studies on resistant and suspectible hosts.

Lucerne—Investigation of factors that determine when different varieties commence growth in the spring; selection of an early strain of lucerne with good agronomic features; breeding lucerne that combines earliness with high production; selection of lucerne capable of growing during drought periods; breeding creeping-rooted lucernes with high productivity and extended growing season; testing lucerne varieties sold in New Zealand; and investigating the relationships of yield components in spaced plants and swards.

Lupins—Breeding of yellow and blue lupins for rapid early growth, low alkaloid content, high seed production, and non-shattering pods.

Linseed and Linen Flax—A rust resistant variety has been produced and a seed supply obtained for field testing.

VEGETABLE PROJECTS

Breeding and Selection—Club-root resistance and uniformity in cabbage and cauliflower; white rot resistance in onions; rust resistance in pole beans; mosaic immunity in wilt resistant peas; wilt resistance in Onward, William Massey, Blue Prussian, and Partridge peas (Onward and Blue Prussion are now ready for release); and spotted wilt resistance in dwarf tomatoes and leaf mould resistance in glasshouse tomatoes (an introduction from Canada has proved to be outstanding in yield, quality, and resistance to leaf mould in trials at Otara and in commercial trials. Further trials and seed increase are in progress).

Other Investigations—Investigations in vegetable brassicas of methods of vegetative propagation which would be of assistance in breeding and selection programmes; the effects of mosaic in cauliflower on yield and quality; the determination of bean rust races in New Zealand and methods of selection for resistance; investigation of sterility factors in Pukekohe Long Keeper onion and their possible utilisation in a hybrid programme; and trials of varieties of sprouting broccoli. A collection of Maori varieties of kumara is now complete and Pacific collections are being made for comparative purposes.

AGRONOMY PROJECTS

The field work has been completed on some of the projects listed in last year's report. Work is being undertaken on: forage yield trials of introduced greenfeed varieties; the factors influencing recovery or death of some greenfeed varieties; the effect of mildew on the forage and seed yield and chemical composition of Cape barley; response to manganese of Arawa wheat growing on a Waimakariri soil; improvement of forage and seed yield of C.R.D. ryecorn and seed increase of improved lines; and selection of Montanum Winter ryecorn plants homozygous for resistance to leaf rust.

PLANT PHYSIOLOGY AND BIOCHEMISTRY PROJECTS

Plant physiology and biochemistry have been combined into one section with combined facilities embodying those of the chemistry laboratory and a small new physiology laboratory.

Nitrogen fixation—An investigation of the structure and significance of a peptide concerned with nitrogen fixation by *Azotobacter vinelandii.*

Biochemical Basis of Aphid Resistance in Rape—The soluble nitrogenous fraction of rape leaves varies in composition between resistant and susceptible lines. Detailed analyses of these fractions are being made from comprehensive material.

Virus Infection and Nitrogen Metabolism in the Potato—Quantitative analyses are being made of the nitrogenous fractions of virus-infected potato tubers.

Mineral Analysis—The effect of irrigation and nitrogen fertilisation upon mineral uptake of crops.

Chemistry of Nitrogen Compounds—Study of the products of the acid hydrolysis of pyrrolidine carboxylic acid.

Kumara Varieties—Biochemical analyses of a collection of true Maori varieties.

Growth Substances—An investigation of suitable experimental methods for extraction, paper chromatographic separation, and assay of growth substances, with particular reference to the physiology of growth correlation.

Seed Yield of Yellow Lupins—Factors causing abscission of flowers and fruits.

NUCLEUS SEED PRODUCTION

This year pure seed of 22 field crop varieties has been produced to provide nucleus seed for the seed certification scheme of the Department of Agriculture. Nucleus seed of six vegetable varieties has been grown for increase and distribution under the Vegetable Seed Approval Scheme.

PUBLICATIONS

Kinetics of Fixation of Nitrogen by *Azotobacter vinelandii. J. Biol. Chem. 224*:351–364. R. M. Allison and R. H. Burris.

Bulk and Pedigree Methods in Wheat Breeding. *Wheat Information Service No. 5*:7–9. L. G. Copp.

Selection for Protein Content in Wheat Hybrids. *Cereal Breeders and Geneticists Conference* 14A–14F. L. G. Copp.

Aotea Wheat – a Replacement for Cross 7. *N.Z. J. Agric 96 (3)*: 210–214. L. G. Copp.

Application of the Zeleny Quality Test in Wheat Breeding. *Cereal Breeders and Geneticists Conference, Longerenong Agric. College, Aug. 1956.* 12A–12B. L. G. Copp and G. M. Wright.

The Effect of Certain Chemicals Upon Sprouting of Potato Tubers. I. Table Potatoes. *N.Z. J. Sci. Tech. A38 (9)*:887–897. C. M. Driver.

Infection of Native Solanum Species by the Potato Blight Fungus. *Nature 180* (4598):1367–1368. C. M. Driver.

A Case of Limitation of Phenotypic Variation. *Ibid. 181* (4606):436. P. H. Fitzgerald.

The Meaning of Good Seed and Vegetable Research. *Tomato, Stone Fruit, and Vegetable J. 10* (296):2, 1956. H. J. Giesen.

Notes on Mendel's Experiments in Heredity. *N.Z. School Science 11*: E. J. Godley.

Unisexual Flowers in the Ericales. *Nature 180* (4580):284. E. J. Godley.

Effect of Leaf Rust on Cereal Forage. *Ibid. 180* (4593): 1000–1001. A. F. Greenall.

Tricotyly in the Tomato. *Ibid. 179* (4553):272. T. P. Palmer.

Variations in Tomato Flowers and Fruits. *N.Z. J. Sci. Tech. A38* (6): 664–668. T. P. Palmer.

The Effect of Growth Substances on Pod-setting in Lupins. *Ibid. A38* (10):1011–1014. R. F. M. Van Steveninck.

Factors Affecting the Abscission of Reproductive Organs in Yellow Lupins (*Lupinus luteus L.*) I. The Effect of Different Patterns of Flower Removal. *Experimental Botany 8* (24):373–381. R. F. M. Van Steveninck.

The Influence of Pea-mosaic Virus on the Reproductive Capacity of Yellow Lupins. *Botanical Gazette 119 (2)*:63–70. R. F. M. Van Steveninck.

The Estimation of Missing Values in Factorial Experiments. *N.Z. J. Sci. 1* (1):1–8. G. M. Wright.

Government-approved Pole Bean Seed Available. *N.Z. Commercial Grower 12* (8):5. D. E. Yen.

A Shiny-podded Mutant in Pole Bean. *N.Z. J. Sci. Tech. A38* (8): 820–824. D. E. Yen.

The Breeding of Peas Resistant to Fusarium Wilt. *Ibid. A38* (7): 702–705. D. E. Yen and I. A. M. Cruickshank.

DIVISION OF NUCLEAR SCIENCES

Director: Mr T. A. Rafter

PROJECTS

Sulphur isotopes; radiocarbon dating; $^{13}C/^{12}C$ isotopic variations in nature; carbon isotopic exchange rates; well-logging; nitrogen uptake studies; ^{14}C natural variations; "atom bomb effect"; tritium as a tracer for water movements; the construction and installation of a 240 curie cobalt source; radioactive fall-out over New Zealand; potassium-argon age measurements; energy transfer mechanisms; theoretical studies; and metabolic paths in nature.

PUBLICATIONS

The Cosmic Ray Flare of 23 February 1956 and its Effects on New Zealand Radiocarbon Dating Equipment. *N.Z. J. Sci. Tech. 38B,* 577 (1957). G. J. Fergusson and G. J. McCallum.

New Zealand ^{14}C Age Measurements, III. *Ibid. 38B,* 732 (1957). G. J. Fergusson and T. A. Rafter.

Reduction of Atmospheric Radiocarbon Concentration Due to Use of Fossil Fuels. *Proc. Roy. Soc. A243,* 561–74 (1957). G. J. Fergusson.

The Atom Bomb Effect – Recent Increase in the ^{14}C Content of the Atmosphere, Biosphere, and Surface Waters of the Oceans. *N.Z. J. Sci. Tech. 38B,* 871–83 (1957). T. A. Rafter and G. J. Fergusson.

The Atom Bomb Effect – Recent Increase of the ^{14}C Content of the Atmosphere and Biosphere. *Science, 126,* 557 (1957). T. A. Rafter and G. J. Fergusson.

Sulphur Isotopic Variations in Nature,

Part I—The Preparation of Sulphur Dioxide for Mass Spectrometer Examination. *N.Z. J. Sci. Tech. 38B,* 849–57 (1957). T. A. Rafter.

Part II—A Quantitative Study of the Reduction of Barium Sulphate by Graphite for the Recovery of Sulphur as Silver Sulphide. *Ibid. 38B,* 955–68 (1957). T. A. Rafter.

Part III—A Study of the Combustion Characteristics of Silver Sulphide and Lead Sulphide for Sulphur Isotopic Measurements. *Ibid. 38B,* 969–81 (1957). T. A. Rafter.

Part IV—Measurement of Sulphur Isotopic Ratio by Mass Spectrometry. *N.Z. J. Sci. 1*:91–102 (1958). J. R. Hulston and B. W. Shilton.

Part V—Sulphur Isotopic Variations in New Zealand Geothermal Bore Waters. *Ibid. 1*:103–126 (1958). T. A. Rafter, B. W. Shilton, and S. H. Wilson.

A Method of Heating Matter of Low Density to Temperatures in the Range 10^5 to 10^6 °K. *Aust. J. Phys. 10*:221–225 (1957). F. B. Knox.

A Method of Heating Matter of Low Density to Temperatures in the Range 10^5 to 10^6 °K. *Ibid. 10*:565–86 (1957). F. B. Knox.

Some Observations on the Behaviour of Bromine Quenched Geiger Tubes. *Ibid. 10*:263–7 (1957). R. E. Belin.

A Gamma Radioactivity Survey of Some of the Geothermal Areas of the North Island of New Zealand. *N.Z. J. Geol. Geophs. 1*:156–65 (1958). R. E. Belin.

DOMINION LABORATORY

Director: Mr F. J. T. Grigg

PROJECTS

Physical Chemistry—Self-heating of wet wool; safety of "Slipemaster" process; temperature coefficient of calomel electrodes; X-ray crystallography of allotropic barbiturates; and infra-red determination of cis/trans isomers of fatty acids.

Metallurgy—Stress corrosion cracking of steel; ageing of quenched duralumin; galvanic relationships of copper alloys in supply waters; corrosion in high temperature bore waters; cracking of welded rails; and cathodic protection of steel structures in sea water.

Petroleum and Road Materials—Examination of petroleum oils, fuels, and road binders; sludging in fuel oil; effect of lubricants on electrical contacts; and tarnishing of silver relay contacts.

Minerals and Building Materials—Water reducing retarders in concrete; analysis of uranium and thorium ores; stabilising viscosity of hot drilling muds; analysis of lignosulphonates; and compilation of rock analyses.

Chemical Engineering—Smoking of bacon; combustion of coal under boilers, etc.; gasification of coal; recovery of lithium from geothermal water; and bloating of clay for lightweight concrete aggregate.

Coal—Investigation of the properties of coal from geological surveys of mine sampling and drilling explorations; investigation of the moisture content of coal at controlled humidity and its relation to the geological history of the coal; and study of natural gas by chromatographic methods to determine the heavier hydrocarbon constituents of bore gases to assist in the search for petroleum.

Geothermal—Determination of total heat content of bore discharges by chemical means. Investigation of the variability of the chemical composition of bore discharges at Wairakei as an aid in estimating the life of the heat resources. Interpretation of data on chemical composition of discharges from bores and springs at Waiotapu as a means of assessing power potential.

Paint—Paint durability on *Pinus radiata* and tawa treated with various water soluble preservatives; paints for permanently immersed steelwork; painting of structural steel at Wairakei and under normal atmospheric exposure; paints for concrete and asbestos-cement; and black stains on lead paints.

Organic—Diphenylamine on fruit when used to control apple scald; mercury in apples and tomatoes; residual metasystox and amiton on fruit after spraying; arsenic uptake of foods from smoke during smoking for preservation; and toxicology and forensic investigations.

Wood—The commercial utilisation of *Dacrydium biforme* resin; the conversion of manoyl oxide and keto manoyl oxide to ambreinolide; the oxidation products of iso phyllocladene; the ether-soluble extractives of matai *(Podocarpus spicatus)* and kawaka *(Libocedrus bidwillii);* seasonal variations in the essential oil composition of *Pinus radiata;* hydridisation studies of *P. radiata* and *P. attenuata* by essential oil composition analysis; graded pH separation of the resin and fatty acid fraction of *P. radiata* resin; and the analyses of lignosulphonate preparations.

Food and Drugs—Examination of foods and drugs for quality and freedom from adulteration, bacteriology of milk products and water; identification of preservatives and colouring substances; and analyses of water for potability and industrial use.

Branch Laboratories—Forensic properties of glass; alcohol in blood; sewage pollution of estuaries, harbours, and rivers; and atmospheric pollution.

PUBLICATIONS

Corrosion by Low-pressure Geothermal Steam. *Corrosion 13*:59–67. T. Marshall and A. J. Hugill.

The Spontaneous Ignition of Wool (1) The Causes of Spontaneous Fires in New Zealand Wool. *J. App. Chem. 7*:468–480. I. K. Walker and H. M. Williamson.

The Composition of Copper Complexes in Cuprocyanide Solutions. *J. Electrochem. Soc. 104*:682–686. H. P. Rothbaum.

Resistance, Power, Voltage, and Current Calculation. *Wireless World 63*: (1957), 18–19. B. E. Jackson.

Cyclic Electrolysis, Part 2. The Influence of Periodic Reversal of Current on the Surface Roughness of Electrodeposited Copper. *Trans. Inst. Metal Finishing 34*: (Advance Copy No. 2). A. Hickling and H. P. Rothbaum.

Chemical Equilibrium in Magmatic Gases. *Am. J. Sci. 255*:416–31. A. J. Ellis.

An Unstable Modification of Aprobarbital. *Nature 179*:1189. P. P. Williams.

Thaw Rigor and the Delta State of Muscle. *Biochem. Biophys. Acta 24*: 427–8. B. B. Marsh and J. F. Thompson.

Commonwealth Specialists Hold Five-year Fuel Conference. *N.Z. Coal 1*:35. W. G. Hughson.

Calculation of Pressure Losses in High Pressure Transmission of Gas. *Coke and Gas*: 1957, 339–41. P. A. Toynbee.

A New Zealand Process of Dehydrating Meat, Pt. 1 *Food*: 1957, 294–8; Pt. 2 *Food*: 1957, 337–9. N. W. Vere-Jones.

The N.Z. Gas Industry. *Gas J. 292*:349. P. A. Toynbee.

Complete Gasification of Coal. *Canterbury Chamber of Commerce Economic Bull. 359*:1957. P. A. Toynbee.

Mercury Content of Apples. *N.Z. J. Sci. Tech. B38*:843–8. H. M. Stone, P. J. Clark, and H. Jacks.

Identification of Amylobarbitone (Amytal) and Pentobarbitone Sodium (Nembutal) in Mixtures, *Analyst 82*:448. E. G. Brooker.

Determination of *p*-chlorobenzyl *p*-chlorophenyl Sulphide (Chlorobenside) and *p*-chlorobenzyl *p*-chlorophenyl Sulfoxide (Chlorobenside Sulfoxide) Residues on Apples. *Agr. and Food Chem. 5*:679–81. C. C. Watson.

The Effect of Sheep-Rumen Contents on Unsaturated Fatty Acids. *Biochem. J. 67*:328–333. F. B. Shorland, R. O. Weenink, A. T. Johns, and I. R. C. McDonald.

Note on Taxifolin and Aromadendrin Acetates. *N.Z. J. Sci. Tech. B38*:697–8. H. V. Brewerton.

DOMINION PHYSICAL LABORATORY

Director: Mr W. H. Ward

PROJECTS

Microclimatology—Investigation of the effects of cultivation techniques on the tension moisture content relationships of soils; investigation of the ripening disorders of tomatoes caused by environmental conditions; further work on the effect of environmental and biophysical factors on the transpiration from leaves; the mechanical properties of plants and plant tissues; the measurement of evaporation from soils and pastures; the moisture movement in unsaturated soils due to a temperature gradient; and measurement of the spectral composition of the all sky radiation incident upon a vertical surface.

Physics of the Thermal Area—A study of the mechanisms of geysers; a theoretical investigation of the effects of convection on the temperatures measured in bores; the development of instruments for measuring very low rates of water flow through soil; measurements on the heat output and stability of thermal areas; and a thermal survey of Waiotapu.

Heat Research—The firmer establishment of thermal conductivity measurements; general advice on thermal insulation and heat problems; and the development of field methods for the thermal conductivity of ground.

Radio Research—Use of a frequency standard in the study of long distance ionospheric propagation at very low frequencies; measurement of ionospheric winds; measurement of radio "whistlers" and similar phenomena; use of radar in the study of auroral ionisation, in conjunction with a wide programme of auroral studies using visual photographic and spectroscopic methods; study of radio propagation through the auroral zone; and study of the lower ionosphere using V.H.F. forward scatter.

Electron Microscopy—Investigation of structure of dentine and enamel in sheep's teeth to find the reason for the improved pastures causing excessive rate of wear; investigation of the structure of dentine in human and sperm whale's teeth to confirm it is identical with sheep's dentine; work on structure of leather and hides with different tanning processes; redesign of photographic enlarger to utilise all information on micrographs; theoretical investigation of distortion in microtomy; analysis of particle counts by the spray drop method; and electron micrographs for Government Departments, research associations, and firms, etc., of clay colloids, zinc oxides, insect virus, soil bacteria, chloroplasts, clover virus, firing clays, metal surfaces, gypsum plaster, and pollen grains.

Engineering Seismology—Use of analogue computer to check the earthquake-resistant design of a 20-storey building for the Auckland City Council; further development of the analogue computer to allow for the effect of yield in a building when subjected to an earthquake; investigation of computer for bearing-wall buildings; maintenance and collection of records from a chain of strong-motion seismographs that give data on earthquakes of engineering value; and instrumentation of a building to record actual stresses and accelerations experienced during an earthquake.

Optical Design—The theory of lens design; the design and use of aspheric lenses; and the development of a fast spectrograph for air-glow studies.

General—Development of an electronic correlator; development of apparatus to study the effect of wind on sea waves; tests (mainly electrical) to encourage improved quality in New Zealand commodities; advice on problems in acoustics; repair and calibration of testing machines for Government Departments, local authorities, technical and university colleges, and industry; checking of gauges used by Army Department for small arms ammunition; and calibration of audiometers, thermometers, and anemometers.

Standards—Establishment of standards of physical measurement in length, mass, force, temperature, pressure, photometry, radiation, and air velocity; maintenance of standards of electrical quantities; the setting up of equipment for testing voltage transformers and current transformers; development of methods for measuring electrical quantities at radio frequencies; and maintenance of the standard-frequency transmissions.

PUBLICATIONS

A Study of the Audio-frequency Radio Phenomena Known as "'Dawn Chorus". *Aust. J. Phys. 10*:286–98. G. McK. Allcock.

The Magnification Caused by Partial Resonance of the Foundation of a Ground Vibration Detector. *Amer. Geophys. Union, Trans. 38*: 928–30. G. N. Bycroft.

The Effect of Surface Wetting on the Transpiration of Leaves. *Phys. Plant. 10*:281–8. R. L. Jones.

The Preparation of Electron Microscope Replicas from Rough Porous Surfaces. *Brit. J. App. Phys. 8*:295–6. D. M. Hall.

The Deterioration of Nitro-cellulose Films Used for Electron Microscopy. *Ibid. 8*:380. D. M. Hall.

Further Evidence of the Antileptospiral Effect of Milk: Electron Microscopic Studies. *Brit. J. Exper. Path. 38*:357–61. L. Kirschner, T. Maguire, and W. S. Bertaud.

Curvature-induced Error in the Analysis of Fading Records. *J. Atmos. Terr. Phys. 11*:255–8. N. J. Rumsey.

Timing Errors in an Equilateral Array of Receivers. *Ibid. 11*:299–300. N. F. Barber.

Optimum Arrays for Direction Finding. *N.Z. J. Sci. 1*:35–51. N. F. Barber.

Determination of Auroral Height by Radar. *Nature 180*:1469–70. R. S. Unwin and M. Gadsden.

Coherent and Incoherent Detectors. *Electron. Rad. Engr. 34*:395. D. D. Crombie.

An Amplifier for A. C. Bridges. *Electron Engg. 29*:597–9. A. H. Allan, J. R. Gabriel, and B. H. Robinson.

An Automatic Instrument for Recording Daytime Ultraviolet. *N.Z. J. Sci. Tech. B38*:820–5. A. H. Allan.

The L-series Emission Spectrum of Krypton. *Phys. Soc. Proc. A70*: 466–73. H. R. Moore.

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ENTOMOLOGY DIVISION

Director: Dr W. Cottier

MAIN PROJECTS

Grass Grub—A study of the biology and ecology of this most important pasture pest, and also of the factors influencing control.

Wheat Stem Weevil in Ryegrass—This pest has recently been found to be damaging ryegrass on a large scale in Canterbury. The biology and habits are being studied as a preliminary to control.

Cruciferous Crop Pests—Designed to provide data on the chemical control of these in the field. The main problem now is the cabbage aphid which destroys large areas of field crucifers. The population dynamics and ecology of the crucifer aphid complex, so important in transmission of virus diseases, is also being studied.

Insects Associated with Leptospermum Species—A study of manuka blight and its progress through the country. The insect concerned, its country of origin, and the biological control complex both in New Zealand and overseas have been investigated.

Clover Case-bearer—This insect is a serious pest in white clover seed areas. Control is being studied in the biological and chemical fields.

Oak Leaf-miner—Parasites of this generally distributed pest have been introduced.

Insect Survey—An endeavour is being made to survey the insects characteristically present on agricultural crops with the object of assessing the importance of the insect complex more scientifically. A start has been made with a survey on grassland in the North Island.

Survey of Parasites of Crucifer Insect Pests—This is being carried out over a period of years to keep abreast of the biological control position in the field. This survey is now in its third year in the North Island.

Development of Forecasting Scheme for Orchard Pests in Nelson—This is an experiment to determine the worth of warning growers about the number of codling moth and leaf-roller prevalent throughout the season as a guide to spraying operations.

Study of Nematodes of Plant and Soil—This is an attempt to place on a more satisfactory basis the work on plant nematodes done in this country and the study of soil nematodes is a new one for New Zealand.

Study of Armyworms Damaging Pasture and Crops—An endeavour to secure information that will help to control these pests which in the last few years have become more widespread in their damage, particularly in the North Island.

Maintenance and Development of Insect Reference Collection—Continuing efforts are being made to build up and improve this collection which is basic to the work of the Division.

Identification Service and Advice Concerning Control of Insects—This service is freely available to anyone who wishes to use it.

Systematic Study of Larval Lepidoptera—This is an endeavour to work out methods of identifying caterpillars to species so that there is no need to rear them to the adult stage, which at present is the only satisfactory form for identification.

OTHER PROJECTS

Leaf-miner in ryegrass; microbiological control of caterpillars; breeding and distribution of green vegetable bug parasites; black beetle investigations; apple leaf-curling midge and parasites; biological control of flies; collection of ragwort seed-fly material for sending to Australia; insect pests of Cook Islands (mainly of *Citrus*); systematic study of scale insects of genus *Eriococcus;* systematics of larval *Melolonthinae;* systematics of aphids, scale insects in general, of Melolonthinae and Thynninae; investigations on sandflies; and cataloguing of New Zealand biological control work.

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Effect of "Metasystox" on the Cabbage Aphid (*Brevicoryne brassicae* (L.)) *N.Z. J. Agric. Res. 1*:37–43. A. D. Lowe.

Incidence and Parasitism of Insect Pests of Cruciferous Crops in Hawke's Bay, Wairarapa, and Manawatu, 1955–56. *N.Z. J. Sci. Tech. A38*: 720–7. D. H. Todd.

Ephialtes brevicornis (Grav). as an External Parasite of the Diamondback Moth, *Plutella maculipennis* (Curt.). *Bull. ent. Res. 48*:477–88. A. Stuart.

FATS RESEARCH LABORATORY

Director: Dr F. B. Shorland

PROJECTS

General Investigations on Animal Fats with Special Reference to those of Meat and Butter—Isolation and identification of minor constituents including branched-chain fatty acids, *n*-odd-numbered carbon fatty acids and unsaturated fatty acids; glyceride structure; variations in the fatty acid composition of animal fats in different tissues and at different stages of growth; and changes in carcass composition in respect of fat, crude protein, and water as influenced by age and diet.

Fat Metabolism in Ruminants—The effect of the rumen on dietary unsaturated fatty acids; the relationship between the dietary and depot fats or ruminants; the use of labelled intermediates to determine the origin of *n*-odd-numbered and branched-chain fatty acids in milk and depot fats of ruminants; and the *trans*-unsaturated acid contents of liver and faecal lipids.

Nutritional Significance and Fate of Minor Constituents of Dietary Animal Fats—Aspects of this general problem being studied in association with the Nutrition Research Department of Medical Research Council include: (a) relationship between certain lipid constituents, such as branched-chain fatty acids, cholesterol deposition, and atherosclerosis, and (b) fate of branched-chain fatty acids in the body.

Nature of Phospholipids in Animal Products—The preparation of pure phospholipid fractions from meat and milk products to determine their composition and their role in the keeping properties and quality of these products.

Rancidity in Animal Fats—Nature of the compounds responsible for the Kreis and thiobarbituric acid tests used to detect incipient rancidity.

Industrial Utilisation of Fats and Fatty Oils—The composition of tall oil from the New Zealand paper industry with a view to its utilisation; modification of the properties of animal fats to widen their usage; development of methods for the synthesis of triglycerides of known constitution; the synthesis of emulsifying agents such as monoglycerides; and plastic fatty coatings from acetoglycerides.

Development of New Techniques for the Investigation of Fats—The application of gas-liquid partition chromatography to the study of fatty acid composition using improved methods for detection and estimation; and simplified methods for the preparation of methyl esters.

Investigations on the Composition of Chloroplasts of Clovers and Grasses—The composition of the lipids of chloroplasts of red clover are being investigated in this Laboratory as part of the major project on bloat being carried out by the Plant Chemistry Division at Palmerston North.

PUBLICATIONS

Some Recently Discovered Constituents of Animal Fats. *J. Amer. Oil Chem. Soc. 34*:129–131. L. Hartman.

Wöhler and the Vital Force. *Education 34*:141–142. L. Hartman.

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The Steam Distillation of Volatile Fatty Acids. *N.Z. J. Sci. 1*:18–22. R. O. Weenink.

FRUIT RESEARCH DIVISION

Director: Mr J. D. Atkinson

PROJECTS

Variety Testing—Trials include some seven hundred imported apple varieties, small blocks of promising local seedlings of peach, plum, feijoa, and Chinese gooseberry, and a small number of imported apricots, citrus, peaches, and subtropical fruit.

Rootstock Testing—Long-term trials of selected apple stocks worked with five scion varieties; plum stocks budded with three varieties; citrus stocks worked with four varieties; and pear stocks budded with one variety. A search for *Phytophthora* resistance in apple stocks is continuing.

Citrus Breeding—Objectives are the production of improved lemons and citrus hybrids suitable for local conditions.

Strawberry Breeding—The objective is to breed resistance to virus and root rot into a strawberry with the desirable characteristics of the Captain Cook variety.

Fruit Descriptions—Formal description and classification of apples and Japanese plums peculiar to New Zealand.

Application of Hormones to Horticulture—Annual certification lists of tomato setting and anti-fruit-drop hormones; early ripening of stone fruits; and preharvest drop of grape fruit.

Chemical Thinning—Apples: effect of reduced concentrations of thinning agents in presence of wetting agents and reactions of treated fruit in cool store; long-term effects of chemical thinning on biennial bearing; and studies on cell size of treated fruits. Stone fruit: attempts to thin peaches chemically.

Orchard Management—Effects of grassing-down on tree growth and yield.

Tree Nutrition—Effects of heavy topdressing on apple yields; foliar application of fertilisers; and effect of urea on fruit set.

Tree Metabolism—Identification of nitrogenous compounds in xylem sap of fruit trees, and quantitative determination of amino acids; and changes induced in apple leaves by application of urea.

Apple and Pear Storage—New methods of scald control with emphasis on dip treatments; orchard factors affecting storage quality, including fertiliser treatment, chemical thinning, pomological variations within varieties; effect of case liners on wilting; studies on variation in maturity of fruit from different parts of the tree; and introduction of controlled atmosphere storage.

Biochemistry of Apple Fruit—Studies on the biochemical factors affecting storage quality of apples with emphasis on the role of nitrogen; attempts to alter cell size in developing fruit; and development of a rapid method of measuring cell size.

Virus Diseases—In cooperation with Plant Diseases Division, identification of virus diseases in tree fruits; effects of such diseases on growth and yield; cross-protection effects; indexing of budwood trees; and methods of raising virus-free trees.

Frost—Measurement of temperatures dangerous to cherries, peaches, and apples.

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The Nucleotide Sequence in Deoxypentosenucleic Acids—

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Maceration of Plant Tissues with Ethylenediamine-tetra Acetic Acid. *Nature 181*:135–6, 1958. D. S. Letham.

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GEOLOGICAL SURVEY

Director: Mr R. W. Willett

REGIONAL PROJECTS

Geological—The preparation of maps and text for publication as regional bulletins is in progress for Morley, Hokonui, Papatowai, and Te Aute subdivisions. Field work continues on Fairlie subdivision, and Pareora subdivision. A summer season's field work was carried out in the Cape Hallett Bay area of the Ross Dependency.

Paleontology—Work on Permian invertebrates was completed and work on Mesozoic belemnites begun at Sedgwick Museum, Cambridge. Research on Jurassic fossils is proceeding. Study of Foraminifera of the

classic Oamaru area is making progress. Pleistocene and Pliocene faunas of the southern half of the North Island are also being studied. Micropaleontology of the Fairlie subdivision is in progress and micropaleontology studies of the Morley subdivision completed. Research on fossil pollen grains and spores has led to advances in correlating of Mesozoic and Tertiary marine and non-marine rocks.

Petrology—Petrological studies of the rocks of the Chatham Islands are proceeding. At the University of Auckland work on Samoan volcanic rocks has been completed and that on Rarotonga volcanic rocks will commence shortly. Petrographic descriptions of rocks from the Morley subdivision is well under way. Regional petrographic studies of the South Island granites has been commenced.

Coal—Preparation of manuscripts and maps of the surveyed coalfields of New Zealand, for publication, is well in hand. Kaitangata coalfield bulletin is now in the press and final manuscript and maps of Ohai completed with that of Huntly proceeding rapidly.

Four-mile Project—The four-mile project is now well under way. The geology and text for two sheets, Wanganui and Christchurch, have been completed and draughting approaches finality. Geology has also been completed for Dannevirke and Invercargill sheets and more than 60 per cent of Taupo and Fiordland sheets. Field work and compilation is in progress for Oamaru sheet. The topographic bases of these maps are being drawn as a joint project with the Department of Lands and Survey.

One-mile Project—A start has been made on the preparation of the geology of the Rotorua one-mile sheet N76 as the beginning of the one-mile project. This project will see the issue of one-mile geological maps complete with geological summary.

SPECIAL PROJECTS

Phosphate Research—The joint effort with the Bureau of Mineral Resources, Geology and Geophysics, Canberra, in the search for phosphate continues. The Cook Island group has been examined and work on Chatham Islands completed. Again the results have been negative, although the search has permitted the completion of the geology of these areas.

Paleontology—A New Zealand stratigraphic lexicon, part of an international undertaking, was completed for publication. Work has begun on a monograph of the fossils of the type Otaian Stage. There has been a great deal of effort by the micropaleontologists, involving consultation work for oil search groups. The microfossils of the type Otaian Stage are also being studied, as are those of the Cretaceous of the Poverty Bay area.

Quaternary Tectonics—This project continues to receive generous assistance from the Civil Aviation Section of the Air Department, particularly in obtaining photographs of certain tectonic features under favourable lighting. The information thus obtained is of great assistance to photo interpretation, some results of which have already been published, and to engineering geological projects.

Glaciology—Glaciological studies have now been placed on a firm basis at the Tasman Glacier and the Franz Josef Glacier. The advice and assistance of Professor R. P. Goldthwait, a Fulbright scholar, on this project has been invaluable. The work will be extended to the

Cameron Glacier, Southern Alps, and to the small glacier on Ruapehu. The presence of large accessible glaciers extending through a temperate zone of latitude makes New Zealand an attractive site for such studies.

Pleistocene History—A number of Pleistocene projects have now been completed and results published, but mapping of Pleistocene deposits still continues in important areas of the North and South Islands. ^{14}C-age determinations are fully used where suitable material can be obtained. A vast and extensive field of fossil spore and pollen studies awaits investigation in the New Zealand Pleistocene. An officer is at present overseas studying Pleistocene research at Cambridge and his visit should result in stimulation and coordination of the work in New Zealand.

Geological Map of New Zealand—A new geological map of New Zealand on a scale of 1:2,000,000 is now going to press. It will appear for distribution as a bulletin with short notes and as a loose map in a suitable folder for general distribution. In order to facilitate the use of this map in the senior forms of secondary schools a brief explanatory text is being provided which will be distributed with copies of the maps issued to secondary schools.

INDUSTRIAL AND ROUTINE PROJECTS

Radioactive Minerals—The geological setting of the occurrence of radioactive minerals in Hawks Crag Breccia is now clearly understood. Until prospecting is pursued with greater vigour further geological work is restricted because of the lack of exposures. Predictions based on the concept of facies within the Hawks Crag Breccia have been borne out by further discoveries. Mineralogical and petrological studies are continuing, but detailed studies of the radioactive minerals themselves call for frequent X-ray determinations and as these have to be made outside the Survey the work proceeds slowly.

Foundation Projects—Dam site investigations are still among the most important aspects of applied geology. The principal areas of work are the Waikato River, Rotorua area, Tongariro area, and on the Waitaki River. Similar attention has been given to large active landslides in the North Island with a view to relocating roads.

Coal Mines—In the coalfields, day to day advice and consultations continue somewhat irregularly, more especially on the West Coast and the Waikato fields.

Ground Water—Calls for advice in the search for ground water continue and there is not likely to be any decrease in this service. Field work in connection with regional ground water studies continues in the Waikato - Taranaki - Hawke's Bay and Nelson areas. In the not too distant future the Survey will have to give considerable attention to this all important mineral resource.

Geothermal—The geological study of the geothermal areas proceeds as an increasing quantity of drill cores become available. Both Wairakei and Waiotapu areas are under consideration. Air photo interpretation continues to be the basic preliminary approach. Detailed petrological studies of hydrothermal alteration and hydrothermally altered minerals remains a prime indicator of the productive potentialities of an area.

Miscellaneous Minerals—Throughout the year numerous miscellaneous metallic and non-metallic minerals are identified and commented on. A few, particularly non-metallic, involve field work, but with many others it is simply a matter of identification.

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GEOPHYSICS DIVISION

Director: Dr E. I. Robertson

PROJECTS

Apia Observatory—Continuous recording and analysis of earthquake data and the earth's magnetic field.

Magnetic Survey—Continuous recording and analysis of the earth's magnetic field at Amberley, Scott Base, and Hallett Station; IGY earth current investigations at Christchurch; and study of secular variation for preparation of magnetic charts for navigation purposes.

Geophysical Observatory—Continuous recording and analysis of ionospheric conditions at Rarotonga, Christchurch, Campbell Island, Hallett Station, and Scott Base; development of h't recorder; calculation of true heights in the ionosphere and theory of layer formation; night-time ionospheric storms; and investigations of radio propagation conditions within New Zealand. Continuous recording and analysis of cosmic radiation at Christchurch and Invercargill.

Seismological Observatory—Continuous recording and analysis of earthquake data at New Zealand, Antarctic, and Pacific island stations; maintenance of New Zealand time service; crustal structure and travel times in the New Zealand region; and IGY latitude-longitude project at Wellington.

N.Z. Oceanographic Institute—Physical oceanography: seasonal variations in coastal circulation around New Zealand; hydrology of off-shore waters; seasonal fluctuations of sea-level; structure of the Antarctic convergence and hydrology of sub-Antarctic waters; and measurements of deep currents.

Marine biology: ecological aspects of bacteriology; microdistribution of plankton in relation to the physical environment; relation of bottom faunas to sedimentary environment; systematics and bibliography of the amphipoda; and seasonal cycle of phytoplankton at Auckland and Wellington.

Marine geology: sedimentation of the continental shelf of the East Coast and Cook Strait; structure and morphology of Cook Strait; structural features of the Kermadec Trench; and sedimentary history of calcareous cores.

Geophysical Survey—Crustal structure of New Zealand; convergence measurements in coal mines; geothermal investigations and drilling; instrumentation for volcanological studies; and gravity surveys in New Zealand and the Ross Dependency.

PUBLICATIONS

Relation between Virtual and Actual Heights in the Ionosphere. *J. Atmos. Terr. Phys. 11*:209–22. G. A. M. King.

Fracturing of the Roof Strata in Coal Mines. *N.Z. J. Sci. Tech. B38*: 992–1000. W. I. Reilly.

Convergence During Cutting of a Longwall Coal Face. *Ibid. B38*:982–991. W. I. Reilly.

Wairakei Hydrothermal System and the Influence of Ground Water. *Ibid. B38*:595–622. F. E. Studt.

Shallow Subsurface Prospecting by the Electrical Resistivity Method at Balclutha. *Ibid. B38*:807–819. T. Hatherton.

The Morphology of the Kermadec and Hikurangi Trenches. *Deep Sea Research 5*. J. W. Brodie and T. Hatherton.

Late Pleistocene Beds, Wellington Peninsula. *N.Z. J. Sci. Tech. B38*:623–43. J. W. Brodie.

Marine Geology of the Chatham Islands Area. *N.Z. Dep. Sci. Indust. Res. Bull. 122*:28–30. J. W. Brodie.

Fossiliferous Concretions from the Shelf South-east of Cape Campbell, New Zealand. *N.Z. J. Sci. Tech. B38*:781–91. H. M. Pantin.

A Variety of Quartzite from Craig-Choinnich Lodge, near Blair Atholl, Perthshire. *Geol. Mag. 94*:409-12. H. M. Pantin.

Age Determinations of Southern Ocean Waters. *Nature 181*:107–8. J. W. Brodie and R. W. Burling.

Hydrology of Chatham Rise. *N.Z. Dep. Sci. Industr. Res. Bull. 122*: 18–27. D. M. Garner.

Seasonal Variation in Sea Water Temperature Within New Zealand Harbours. *N.Z. J. Geol. Geophys. 1*:192–218. T. M. Skerman.

The Sampling Problem with Particular Reference to Marine Organisms. *Proc. N.Z. Ecol. Soc. 4*:37–9. R. M. Cassie.

Shallow Water Diving in Marine Ecology. *Ibid. 5*:4–5. R. M. Cassie.

Condition Factor of Snapper, Chrysophrys Auratus Forster in Hauraki Gulf. *N.Z. J. Sci. Tech. B38*:375–88. R. M. Cassie.

Studies on the New Zealand Amphipodan Fauna No. 14. The Genera Hyale and Allorchestes. (Family Talitridal). *Trans. roy. Soc. N.Z. 84*:903–33. D. E. Hurley.

Some Amphipoda Isopoda and Tanaidacea from Cook Strait. *Zoo. Pub. Vict. Univ. Coll. 21*. D. E. Hurley.

On Whale-lice (Amphipoda: Cyamidae) from the California Grey Whale, Eschrichtius Glaucus. *J. Parasit. 43*:352–7. D. E. Hurley and J. L. Mohr.

Apia Observatory Magnetic Results for 1952.

Ionospheric Data: Godley Head 1955; Rarotonga 1955; Campbell Island 1954.

GRASSLANDS DIVISION

Director: Dr P. D. Sears

PROJECTS

Plant Physiology—The influence of environment and of defoliation on the growth patterns of major pasture species; influence of different levels of temperature and light on the growth of pasture species, and on the proportion of plant tissue constituents, under controlled environments; daily changes in growth of ryegrass in a pasture; the annual changes in tiller number of various species in unit pasture areas; the establishment of a series of microclimate stations through New Zealand; the production, under various conditions, of rapid growth of ryegrass believed to be associated with facial eczema; and the effect of nitrogen and of other plant nutrients on the seasonal growth, and on the summer survival, of ryegrass strains.

Plant Breeding and Genetics—Maintenance and improvement of the following species and strains; perennial ryegrass, Italian ryegrass, H. 1 ryegrass, cocksfoot, timothy, white clover, broad red clover (cowgrass), Montgomery red clover, *Lotus uliginosus, Lotus corniculatus,* zigzag clover, H. 1 perennial ryegrass hybrids, tall fescue, and hybrids with perennial ryegrass. Improved strains of the first eight of the above species have already been released and are under Government certification, but further improvement work is being carried out on them as well as on those not yet released. In addition, single plant and sward comparisons are continuously under way of several other species and strains, particularly of strawberry clover, subterranean clover, and meadow fescue. Other projects are: trials of zigzag clover in South Island tussock country; the production of a white clover strain that breeds true for an easily identifiable leaf marking; the production genetics of ryegrass; the production and study of polyploids in red clover and *Lotus*; studies to ascertain whether genetic differences exist between plants in their ability to grow at different levels of mineral

nutrients and their ability to absorb mineral nutrients; biochemical genetical studies of anthocyanins and related polyphenols in white clover; and studies of techniques with the aim of improving certification procedures, notably node counts in red clover strains.

Soil Fertility—Survey of build-up of organic matter and organically bound nutrients in important North Island soils under pasture; reasons for the differential response of red and white clover to sulphate; movement of sulphate in soil; major and minor element effects on establishment of clovers on Wharekohe silt loam, a Northland "gumland" soil; and effects of treading of sheep on pasture production and on soil structure and compaction.

Pasture Ecology—The rate of increase of soil fertility under pastures of different botanical composition and with different management, and the rate of decrease under different cropping systems; the effect of artificial nitrogen on seasonal and total production; effects of mineral fertiliser, phosphorus, sulphur, lime, and molybdenum; grass grub and its effect on different species; effects of grazing intensity on seasonal production, and its relationship with leaf area and total light interception at different seasons of the year; clover inoculation; seed dormancy of pasture grasses; seedling growth of pasture species; the use of hormone sprays for weed control; the introduction of grasses and legumes into established pastures by overdrilling; establishment of new pastures; comparison of farming systems for fat-lamb production on lowland; hill country management in relation to soil conservation and animal thrift; and collaborative trials with Crop Research Division on the performance of new potato and wheat varieties under high soil fertility at Palmerston North.

PUBLICATIONS

The Influence of Nitrogen and Moisture Supply on the Growth of Pastures during Summer. *Emp. J. exp. Agric. 25*:69–78. K. J. Mitchell.

Pasture Growth Rate Studies in Relation to Grazing Management. *Proc. 17th Conf. N.Z. Anim. Prod. Soc.*:46–55. R. W. Brougham.

Effects of Changes in Light and Temperature on Roots of Perennial Ryegrass *(Lolium perenne* L.) *N.Z. J. Sci. Tech. A38*:783–92. Kathleen Soper.

Pasture Plant Breeding in New Zealand. *Agric. Rev. 3*:31–7. L. Corkill.

Have New Pasture Species Increased the Hazards of Grazing Stock? *Proc. Ruakura Farm. Conf. 1957*: P. D. Sears.

Grazing Management in Relation to Pasture Production. *Ibid.*:144–55. R. W. Brougham.

Some Factors that Influence the Rate of Growth of Pasture. *Proc. 19th Conf. N.Z. Grass. Assn.*:109–16. R. W. Brougham.

The Influence of Treading on Pasture. *Ibid.* 82–89. D. B. Edmond.

Improvement of *Lotus uliginosus. Ibid.* 75–81. P. C. Barclay.

Evaluation of General and Specific Combining Ability in Perennial Ryegrass. *N.Z. J. Sci. Tech. A38*:1026–35. J. H. Torrie (Fulbright Fellow attached to Grasslands Div.).

The Spraying of Established Pastures. *Proc. 10th N.Z. Weed Control Conf*: D. B. Edmond.

Interception of Light by the Foliage of Pure and Mixed Stands of Pasture Plants. *Aust. J. agric. Res. 9*:39–52. R. W. Brougham.

The Light Regime within Pastures. *N.Z. J. agric. Res. 1*:61–8. K. J. Mitchell and D. M. Calder.

Genetic and Environmental Components of the Productivity of Perennial Ryegrass (*Lolium perenne* L.). *N.Z. J. agric. Res. 1*:86–103. S. O. Fejer.

Effects of Differences in Light Intensity and Temperature on the Anatomy and Development of Leaves of *Lolium perenne* and *Paspalum dilatatum*. *Ibid. 1*:1–16. K. J. Mitchell and Kathleen Soper.

Some Effects of Treading in Pasture. *Proc. 18th Conf. N.Z. Anim. Prodn. Soc*: D. B. Edmond.

Some Aspects of Microclimate as it Affects Fine Turf. *Proc. Conf. N.Z. Golf Greenkeepers' Assn*: (Christchurch 1957). G. S. Harris.

The Effects of Latent Germination of Buried Weed Seed on Fine Turf. *Ibid.* (Rotorua 1958). G. S. Harris.

Comparative Morphology of the N.Z. Species of *Pseudopanax* and *Nothopanax*. *Trans. Roy. Soc. N.Z. 84*:749–55. Kathleen Soper.

HOP RESEARCH STATION

Superintendent: Dr R. H. J. Roborgh

PROJECTS

From a total of 3,300 seedlings two have been finally selected as being superior to the commercially grown Californian variety after trials for susceptibility to root rot (*Phytophthora* sp.), quality, and yield. Propagation on a commercial scale of these two varieties and of the English Bullion variety will be commenced at the Marsden Farm of the Cawthron Institute in the season to come. Cuttings of these new varieties should be available to hop growers in spring 1960.

Further progress has been made in the study of the physiology of the hop plant. Defoliation of alternate nodes during the period of development of the main bine reduced the length and thickness of all laterals and the 50 per cent loss of leaf area resulted in a 50 per cent reduction in yield.

Breeding—The study of botanical characters to aid differentiation of hop varieties; the introduction and evaluation of hop varieties from overseas; the breeding of new hop varieties resistant to root rot (*Phytophthora* sp.); the germination of hop seed; the technique of testing for susceptibility to root rot at the seedling stage; the technique of rapid propagation of promising seedlings; and the raising of polyploids.

Ecology—Investigating the influence of air and soil temperatures on the development of the hop plant; wiring the hop garden at different heights; spacing the hop hills; cultivation and cover cropping on different soil types; manuring, particularly for influence on the occurrence of root rot; pruning at different times throughout the year; the evaluation of different stringing methods; training different types of bines; picking by hand with and without cutting the bines; and drying conditions.

INFORMATION BUREAU

Officer in Charge: Mr N. A. Marris

PROJECTS

The Information Bureau is responsible for the editing and publishing of three scientific journals and of other departmental publications, the provision of a central library service (including reference facilities, cataloguing, inter-library lending, book ordering, and assistance to branch libraries), and the maintenance of a technical information section, a public relations and publicity section, a photographic section, and a photocopy service. In addition, a *D.S.I.R. Newsletter* is issued each month for staff information, and certain translation work is undertaken.

PUBLICATIONS

The *New Zealand Journal of Science and Technology* (Agricultural Research Section, and General Research Section) ceased publication, at the end of Volume 38, on 31 December 1957. It was replaced at the beginning of 1958 by three new journals, namely, the *New Zealand Journal of Agricultural Research* (published in alternate months), the *New Zealand Journal of Geology and Geophysics* (quarterly), and the *New Zealand Journal of Science* (quarterly).

The Bureau has also, during the year, edited and published 20 bulletins and other publications on behalf of the Department and its branches.

PLANT CHEMISTRY DIVISION

Director: Dr A. T. Johns

PROJECTS

Proteins—The isolation and characterisation of nucleoproteins of white clover and spinach; a survey of the seasonal variation in level of protein extractable from white clover; the isolation and characterisation of the virus infecting white clover in pasture; the physico-chemical study of the dissociation of turnip yellow mosaic virus (in conjunction with Plant Diseases Division); and the isolation and characterisation of protein extracted from cereal roots.

Non-protein Nitrogen—The nitrate and organic nitro compounds of ryegrass under different growing conditions in relation to "hogget ill-thrift"; the non-protein nitrogen compounds in rapidly growing grasses and clovers from the point of view of plant metabolism and animal nutrition; the "bound amino acid" fraction in the nodules of legumes; and underground transference of nitrogen from clover to grass.

Iodine Nutrition of Grazing Animals—The iodine nutrition of sheep as affected by possible goitrogenic principles in white clover and the low iodine status of some grass species.

Mineral Nutrition—The calcium and magnesium levels in herbage and its relation to the deficiency of these elements in the animal.

Facial Eczema—The large-scale concentration of toxin from "facial eczema" grass.

Carbohydrate Chemistry—Investigation of spray reagents for detecting sugars in paper chromatography; carbohydrate composition of grasses and clovers; polysaccharides and sugars in relation to bloat; polysaccharide metabolism of *Streptococcus bovis;* structure of dextrans; and protozoan carbohydrates.

Lipids—Studies on the chloroplast fat of plants and its fate in the rumen (in conjunction with Fats Research Laboratory).

Ruminant Physiology—Chemical composition of bovine parotid, submaxillary and residual salivas; chemical structure of submaxillary mucoprotein; studies on salivary secretion in relation to feeding, ruminating and bloating; analysis of the food bolus; nitrogen metabolism in the rumen; effect of penicillin on rumen chemical composition; examination of the foaming properties of proteins, saponins, and salivary mucoproteins and rumen liquor under different conditions; antifoaming properties of particulate matter in the rumen; and rumen lipids. Mechanical activity of reticulum and rumen; treatment and prophylaxis of bloat with antifoaming agents and penicillin; effects of the ingestation of paraffins by ruminants; and effects of calcium level in blood on the activity of reticulum and rumen.

Microbiology—The isolation and culture of rumen bacteria and protozoa and a study of their nutrition and metabolism, particularly in relation to bloat; survival of clover and *lotus rhizobia* in gumland soil, and the effect of innoculation on the establishment of these legumes in North Auckland; study of the distribution and effectiveness of *lotus rhizobia* in different soils; and investigation on a method for the measurement of the nitrogen-fixing ability of different pasture legumes.

PUBLICATIONS

Iodine Content of Pasture Plants. *Physiol. Plant. 10*:100–111. J. M. Johnson and G. W. Butler.

Goitrogenic Effect of White Clover (*Trifolium repens* L.) II. *N.Z. J. Sci. Tech. A38*:793–802. G. W. Butler, D. S. Flux, G. B. Petersen, E. W. Wright, A. C. Glenday, and J. M. Johnson.

Effects of Ingestion of Paraffins by Ruminants—

I. *Ibid. A38*:825–38. C. S. W. Reid.

II. *Ibid. A38*:839–52. F. H. McDowall, W. A. McGillivray, and C. S. W. Reid.

Bloat in Cattle on Red Clover, II—The Tympanograph, a Simple Apparatus for Recording Abdominal Girth Changes in Stalled Animals. *Ibid. A38*:853–66. C. S. W. Reid.

New Light on Clover Nitrogen. *Proc. 10th Ann. Mtg. Dairfrms., Massey Agric. Coll. 1957*:55–61. G. W. Butler.

Penicillin and Bloat. *Ibid. 1957*:52–54. A. T. Johns.

Bloat in Cattle on Red Clover, III—Treatment and Prevention with Antifoaming Agents. *N.Z. J. Sci. Tech. A38*:908–27. C. S. W. Reid and A. T. Johns.

Bloat in Cattle, IV—A Comparison of the Chemical Composition and Foaming Properties of Extracts of Bloating and Non-bloating Clover. *Ibid. A38*:956–65. J. L. Mangan and A. T. Johns.

The Effect of Sheep Rumen Contents on the Unsaturated Fatty Acids. *Biochem. J. 67*:328. F. B. Shorland, R. D. Weenink, A. T. Johns, and I. R. C. McDonald.

A Progress Report on a Ryegrass Strain Trial with Particular Reference to Hogget Ill-thrift and Facial Eczema. *Proc. 20th Ann. Meeting Sheepfrms. Massey Agric. Coll. 1957*:181–91. G. W. Butler and A. L. Rae.

Bloat in Cattle—

V—Effects of Ingestion of Whale Oil on Production and Composition of Milk, on Flavour of Milk and Butter, and on Properties of Butterfat. *N.Z. J. Sci. Tech. A38*:1037–53. F. H. McDowall, M. R. Patchell, and C. S. W. Reid.

VI—Effects of Ingestion of Linseed Oil, Soya Bean Oil, Mixed Beef and Mutton Tallow and Peanut Oil on Production and Properties of Milk and Butterfat. *Ibid. A38*:1055–80. F. H. McDowall, C. S. W. Reid, and M. R. Patchell.

Bloat. *N.Z. vet. J. 5*:115–18. A. T. Johns, J. L. Mangan, and C. S. W. Reid.

Localisation of Fraction I—Protein in Chloroplasts and its Identity with Ribulose Diphosphate Carboxylase. *Arch. Biochem. Biophys. 73*:120–26. J. W. Lyttelton.

Photosynthesis. *N.Z. Inst. Chem. J. 21*:111. J. W. Lyttelton.

The Significance of Oligosaccharide Intermediates in Dextran Synthesis. *Nature 179*:310. R. W. Bailey, S. A. Barker, E. J. Bourne, M. Stacey, and O. Theander.

Inmunopolysaccharides—

VI—The Isolations and Properties of the Dextransucrose of *Betacoccus arabinosaceous*. *J. chem. Soc.*:3530–35. R. W. Bailey, S. A. Barker, E. J. Bourne, and M. Stacey.

VII—The Transglucosidase Action of *Betacoccus arabinosaceous* Dextran Sucrose. *Ibid.* 3536–41. R. W. Bailey, S. A. Barker, E. J. Bourne, and M. Stacey.

Animal Factors in the Etiology of Bloat. *Proc. 18th Conf. N.Z. Anim. Prod. Soc.*: A. T. Johns, J. L. Mangan, and C. S. W. Reid.

Studies on the Amide and C-terminal Residues in Proteins—

II—The Ammonia Nitrogen and Amide Nitrogen of Various Native Protein Preparations. *Biochem. J. 68*:111–13. A. C. Chibnall, J. L. Mangan, and M. W. Rees.

III—The Esterification of Proteins. *Ibid. 68*:114–18. A. C. Chibnall, J. L. Mangan, and M. W. Rees.

V—Estimation of Asparagine and Glutamine Residues. *Ibid. 68*:122–28. A. C. Chibnall, C. Haselbach, J. L. Mangan, and M. W. Rees.

PLANT DISEASES DIVISION

Director: Dr E. E. Chamberlain

PROJECTS

Entomology—General: taxonomy of beetles of the group Aphodiinae; reorganisation of beetle collections; national survey of red spider mites on apple trees (in conjunction with Horticulture Division, Department of Agriculture); and collection and identification of plant galls and plant parasitic mites.

Insecticides: Physiological effect of DDT on insects; and assessment of malathion as an insecticide.

Insect resistance in plants: Investigations of aphid resistance in Brassica crops.

Economic Mycology—Studies on physiological races and varietal resistance of French-bean rust, tomato leaf mould, and verticillium wilt (cooperative projects with Crop Research Division); determination of host range of verticillium wilt and its control in the soil with fungicides; control of grey mould (*Botrytis cinerea*) on ornamental plants under glass: studies on prevention of silver leaf infection by overall sprays to protect newly made pruning cuts; field tests on control of big vein of lettuce with fungicides applied to the soil; therapeutant control of lettuce ring spot; testing apple root stocks for resistance to apple collar rot; and control of banana stem end rot with fungicides.

Investigations on death of pines: Association of *Phytophthora* species in the soil with pine tree death; identification and distribution of *Phytophthora* species in forest soils; and testing pathogenicity of species isolated.

Field crop diseases: Field survey of wheat diseases in Canterbury Province (in conjunction with Crop Research Division), resistance of wheat varieties to take-all disease; relative importance of seed vigour, soil conditions, and seed dusts on establishment of wheat crops; control of potato pink rot with fungicides applied to the soil; control of white rot of onions by pelleting seeds with fungicides; life history studies on the fungus causing dry rot of brassicas; control of dry rot and club root of brassicas with fungicides; studies on resistance of strains of long-rotation rye grass to crown rust; and testing of hop seedlings for resistance to black root-rot disease.

Identification and recording fungi responsible for plant diseases; and maintenance of a list of all plant diseases recorded in New Zealand.

Systematic Mycology—Collection and identification of New Zealand fungi for herbarium; studies in classification and life histories of New Zealand Pyrenomycetes belonging to the genera *Nectria, Hypocrea, Gibberella,* and *Hypomyces* in the Hypocreaceae; *Hypoxylon* and *Rosellinia* in the Sphaeriaceae; studies on the Myxomycetes of New Zealand; and taxonomy of Streptomycetes from New Zealand soils.

Bacteriology and Microbiology—Studies on control of bacterial spot of plum and peach, and soft rot of vegetables; protection of seedlings and cuttings against infection with crown gall by use of chemicals including antibiotics; and studies on bacterial diseases of mulberry and iris.

Antagonistic properties of the Streptomycetes in New Zealand soils; and examination of soil samples from Antarctica for actinomycetes.

Investigations on the keeping qualities of frozen milk; and development of mould on crumpets in sealed bags.

Maintenance of certification scheme for legume seed inoculants; serological typing of *Rhizobium* strains; search for improved strains; determination of *Rhizobium* number per seed necessary for efficient inoculation of seedlings; and maintenance of tested *Rhizobium* strains and supply of experimental cultures.

Virus Diseases—Search for insect vectors of virus disease of clovers; attempts to prepare satisfactory antisera for turnip mosaic, cauliflower mosaic, and potato virus Y; studies on field resistance of turnip and swede varieties to turnip mosaic and cauliflower mosaic; and studies on the early stages of infection with tobacco mosaic virus.

Changes in RNA content of tobacco leaves during infection with tobacco mosaic virus; studies on the structure of tobacco mosaic and turnip yellow mosaic viruses; attempts to synthesise deoxyribose nucleosides as possible growth inhibitors; metabolism of 8-azapurines in plants

and bacteria; and tests on the inhibition of plant virus multiplication by chemicals.

Plant Physiology—Investigations into the role of humidity, shading, temperature, and tobacco mosaic infection in the development of blotchy ripening of tomatoes grown under commercial glasshouse conditions.

Plant Therapeutants—The maintenance of a system of certification of plant therapeutants; the chemical control of insect pests and fungous diseases, e.g., soil and seed treatment for carrot rust fly; persistance of systematic insecticides as seed treatments; soil treatments, and sprays; effect of insecticide concentration and spray interval on control of onion thrips; effectiveness of acaricides against red mite and clover mite on apple; organic phosphorus insecticides against codling moth; control of apple black spot, ripe spot, and bitter rot by integrating eradicant and protectant fungicides into a programme related to spore discharges, infection periods, and fungous biology; comparison of organic mercury and thiram, dichlone, and captan for control of wheat bunt and oat smut; and biology and control of peach rust.

Laboratory insecticide and fungicide testing; out-of-doors persistance of DDT and dieldrin deposits; effect of bordeaux mixture and lime sulphur on BHC toxicity; toxicological studies with the miticides, aramite, malathion, and amiton; toxicity of insecticides to different instars of the green vegetable bug; studies on relation between physical form and toxicity of insecticide deposits; relation between physical form and fungicidal performance of copper oxychlorides (in collaboration with Dominion Laboratory); and the extent of protectant and erradicant effects of fungicides against various organisms.

Timber Preservation—Studies on toxicity of Tanalith "C" and "U", and Boliden "S25" against *Anobium;* toxicity of boric acid and zinc chloride against *Ambeodontus;* persistance of control of borers in plywood through use of dieldrin in the glue line; and studies on egg laying of *Anobium.*

PUBLICATIONS

Third Supplement to "A Revised List of Plant Diseases Recorded in New Zealand" 1955–57. *N.Z. J. Sci. Tech. A38 (7)*:777–782. R. M. Brien and Joan M. Dingley.

Disease and Pest Control. *N.Z. Inst. for Turf Culture – 7th Report on Greenkeeping Res.*: 67–74, 1957. R. M. Brien and E. V. Arnold.

Diseases and Pests of Lettuce in New Zealand and their Control. *N.Z. Dep. Sci. Industr. Res. Inf. Ser. 14*: R. M. Brien, D. W. Dye, P. R. Fry, R. A. Harrison, H. Jacks, and F. J. Newhook.

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Additions to the Smut Fungi of New Zealand, II—*Trans. roy. Soc. N.Z. 84 (4)*:643–648, 1957. Shirley D. Brook.

Certification of Legume Seed Inoculants. *N.Z. Farmer 78 (18)*:8, 1957. E. E. Chamberlain.

Occurrence of Peach Calico in New Zealand. *N.Z. J. Sci. Tech. A38 (8)*:813–819, 1957. E. E. Chamberlain, J. D. Atkinson, and J. A. Hunter.

A Chromatographic Analysis of the Free Amino Acids, Organic Acids and Sugars in Flax (*Linum usitatissimum*). *J. Sci. Food Agric. 8*: 26–30, 1957. I. A. M. Cruickshank.

Thelephoraciae of New Zealand. The Genera Thelephora and Tomentella. *Trans. roy. Soc. N.Z. 84 (3)*:479-487, 1957. G. H. Cunningham.

Thelephoraciae of New Zealand 13. The Genus Coniophora. *Trans. roy. Soc. N.Z. 84 (3)*:487-496, 1957. G. H. Cunningham.

Certification of Legume Seed Inoculants. *N.Z. Farmer.* 1957. G. H. Cunningham.

Certification of Therapeutants and Plant Hormones. *N.Z. Dep. Sci. Industr. Res. Inf. Ser. 13*: 1957. G. H. Cunningham and J. D. Atkinson.

Life-history Studies of New Zealand Species of *Nectria* Fr. *Trans. roy. Soc. N.Z. 84 (3)*:467-477, 1957. Joan M. Dingley.

Life-history Studies in the Genus *Hypocrea* Fr. *Trans. roy. Soc. N.Z. 84 (4)*:689-693, 1957. Joan M. Dingley.

Studies on Horticultural Formulations of Streptomycin. *N.Z. J. Sci. Tech. A38 (9)*:898–907, 1957. M. H. Dye.

Development of Streptomycin-resistant Variants of *Pseudomonas syringae* van Hall in Culture and in Peach Seedlings. *N.Z. J. agric. Res. 1 (1)*:44–50, 1958. M. H. Dye.

Mist Propagation—Demonstration at Mt. Albert Research Station. *N.Z. Gardener 13 (12)*:851. J. A. Hunter.

A Note on *Tecomanthe speciosa,* a Recent Addition to New Zealand Climbing Plants. *J. roy. Hort. Soc. 82 (10)*:437–8, 1957. J. A. Hunter.

Note on Transmission of Apple Mosaic by Natural Root Grafting. *N.Z. J. agric. Res. 1 (1)*:80–82, 1958. J. A. Hunter, E. E. Chamberlain, and J. D. Atkinson.

Mercury Content of Apples. *N.Z. J. Sci. Tech. B38 (8)*:843–848, 1957. H. Jacks, H. M. Stone, P. J. Clark.

Field Guide to Red Spider Mites Infesting Fruit Trees. *Orchardist of N.Z. 30 (9)*:22–3, 1957. K. P. Lamb.

Quantitative Micro-analysis of Leaf Tissue for Certain Organic Constituents with Special Reference to Sampling Error. *N.Z. J. Sci. Tech. B38 (9)*:1009–1017, 1957. K. P. Lamb.

The Biological Effects of 8-azapurines. *Ciba Foundation Symposium. Chemistry and biology of Purines.* ed. by G. E. W. Wolstenholme and Cecilia M. O'Connor:270–285. London, Churchill, 1957. R. E. F. Matthews.

Contributions to Biology from Studies on Viruses. (Hudson lecture delivered to the Wellington Branch of the Royal Society of N.Z., 1957.) *N.Z. Science Review 15 (11–12)*:87–92, 1957. R. E. F. Matthews.

The Metabolism of 8-azapurines. *Biochem. J. 66 (2)*:323–333, 1957. R. E. F. Matthews, J. D. Smith.

The Association of *Phytophthora cinnamomi* with Dying and Unthrifty *Pinus radiata*. *N.Z. Soil News*:90–91, 3, 1957. F. J. Newhook.

Leaf Mould of Tomatoes. *N.Z. Commercial Grower 13 (2)*:9, 1957. F. J. Newhook.

Notes from a North American Tour. *Ibid. 13 (3)*:10, 1957. F. J. Newhook.

High Humidity Major Factor in Blotchy Ripening in Glasshouse Tomatoes. *Ibid. 13*:9, 1958. C. H. Proctor.

Anther Smut of Carnations – Outbreak Recorded in New Zealand. *N.Z. Gardener 13 (12)*:800–1, 1957. J. A. Robinson.

Control of Carnation Diseases in New Zealand. *N.Z. Plants and Gardens 2 (5)*:212–218, 1957. J. A. Robinson.

Didymella Danger. *Tomato, Stone Fruit, and Vegetable J. 10 (302)*:2, 1957. H. C. Smith.

Biology of Parasitic *Pythium* and *Phytophthora* Species. *N.Z. Soil News 3*:83–90, 1957. H. C. Smith.

Mercury and Copper as Soil Fungicides. *Ibid. 3*:98–102, 1957. H. C. Smith.

Ring Spot Disease of Lettuce (and its Control). *N.Z. Commercial Grower 13 (6)*:10, 12, 14, 1957. H. C. Smith, L. C. Hurndell.

Actinomycetes in New Zealand Soils (Abstract). *N.Z. Soil News 3*:97, 1957. T. R. Vernon.

A New Species of Lithocolletis (Lepidoptera:Gracillariidae) from N.Z. *Proc. roy, Ent. Soc. London (B) 26 (1–2)*:26–28, 1957. K. A. J. Wise.

Trials for Control of Chrysanthemum Gall Midge *(Diarthronomyia chrysanthemi* Ahlberg). *N.Z. J. Sci. Tech. A38 (7)*:728–734, 1957. K. A. J. Wise.

SCIENTIFIC LIAISON SERVICE

Officer in Charge: Mr N. A. Marris

ACTIVITIES AND PROJECTS

London—The office has continued to act on the following Commonwealth and special committees: Commonwealth Advisory Aeronautical Research Committee, Commonwealth Advisory Committee on Defence Science, Commonwealth Agricultural Bureaux, Board of Governors of the Imperial College of Science and Technology, Food Investigation Board, Organisation for European Economic Cooperation, and the Pest Infestation Board. During the past six months our Senior Scientific Liaison Officer has acted as Chairman of the Committee of the British Commonwealth Scientific Office.

Other activities have included administration and oversight, in the United Kingdom, of New Zealand National Research Fellows and of members of the New Zealand Defence Scientific Corps; and work relating to the International Geophysical Year, the Atomic Energy Agency, dehydrated meat trials, and the obtaining of isotopes for New Zealand.

A number of scientific conferences were attended during the year, arrangements were made for New Zealand scientists visiting the United Kingdom officially, and work on the recruitment of scientific staff continued.

In addition to the above, the office has kept New Zealand advised of recent scientific work and developments.

Washington—The work of the office has been concerned, as previously, with the acquisition of publications, government and otherwise, dealing with any phase of scientific research and subjects relating thereto. In

the past year the latter has included a great deal with respect to education, development and remuneration of scientists and engineers, documentation, and the practical application of technical research for small businesses and factories. Assistance has been given to New Zealand scientists and technical information has been obtained and forwarded. New Zealand research papers have continued to be made available to research workers in the United States.

SOIL BUREAU

Director: Mr N. H. Taylor

PROJECTS

Agricultural

Soil Surveys—North Island: Waiotapu (40 ch./in.), Manawatu-Rangitikei sand country (40 ch./in.), revision of Sheet 8, North Island map (4 m./in.), Peat survey, Paekakariki-Paraparaumu (40 ch./in.), Gisborne plains (20 ch./in.). South Island: Ellesmere County (40 ch./in.), Paparua County (40 ch./in.), Kowai County (2 m./in.), Taieri Plains (40 ch./in.), Upper Clutha (40 ch./in.), General survey, South Island (4 m./in.), Maniatoto Plains (40 ch./in.), Lower Manuherikia Plains (20 ch./in.). Pacific: Chatham Is. (1·7 m./in.), Western Samoa (1·7 m./in. and 40 ch./in.), Fiji (2 m./in.).

Special Investigations—Residual effects of phosphate topdressing in New Plymouth black loam; relation of dental caries to soil type; analytical methods for soils; potassium-supplying power of New Zealand and Pacific soils; systematic survey of soil colloids; survey of available minerals in soils as extracted by sweet vernal; clay mineralogy of soils of New Zealand and the Pacific islands; mechanisms of ion absorption; copper survey of main New Zealand soils; source of radioactivity of some New Zealand soils; texture standards; survey of physical properties of main genetic groups; laboratory testing of drainage promoting chemicals; field trials of soil pugging and surfactants; frost action in soils under snow tussock grassland; hydrology in the Taita native catchment; biological investigation of tussock grassland soils – changes due to farming; identification of soil basidiomycetes by a serological method; reconnaissance survey of tussock grasslands in North Island: mycorrhizae and plant growth; earthworm survey of New Zealand soils; and fertility of a Niue Island soil.

Forestry

Soil survey of Tairua State Forest; soil survey of Ngaumu State Forest (20 ch./in.); soil survey of Kaingaroa Forest (40 ch./in.); soil fertility in Golden Downs State Forest; and chemical investigation of litter and humus of red beech.

Engineering

Corrosion of mild steel and cement asbestos in soils; cathodic protection of steam-bore casings at Wairakei; frost action of soils under highways; physical properties of New Zealand estuarine soils; effect of rate of loading on soil consolidation; and sensitivity of clays at Whangamarino resulting from consolidation.

PUBLICATIONS

Botanical Survey of an Experimental Catchment, Taita, New Zealand. *N.Z. Dep. Sci. Industr. Res. Bull. 124*:81 pp. A. P. Druce.

A Study of the Sensitivity Resulting from the Consolidation of a Remoulded Clay. *4th Int. Conf. Soil Mechanics and Foundation Engng. 1*:83–86. P. L. Newland and B. H. Allely.

The Availability of Potassium in Soil. *2nd Aust. Conf. Soil Sci. 1, Pt. II. (42)*:1–12. A. J. Metson.

Soils of the Lower Clutha Plains. *N.Z. Soil Bureau Bull. 15*:40 pp. E. J. B. Cutler, J. Richards, and T. W. Collie.

Soil Studies Using Sweet Vernal to Assess Element Availability, Pt. 3—Copper in New Zealand Soil Sequences. *N.Z. J. Sci. Tech. B38*:884–902. N. Wells.

Patterned Ground at a High Country Station. *Ibid. B38*:793–806. M. W. Gradwell.

Some Recent Advances in Clay Minerals Research. *J. N.Z. Inst. Chem. 21*:128–138. L. D. Swindale.

Soil Science in the U.S.S.R. *N.Z. Soc. Soil Sci. Proc. 2*:12–16. N. H. Taylor.

The Soils of Canterbury. *Ibid. 2*:18–19. W. T. Ward.

Second Thoughts on Soils of the High Country. *Ibid. 2*:23–25. J. D. Raeside.

Soil Development on Peat. *Ibid. 2*:25–27. W. F. Harris.

Some Pedological Problems of Forestry in the South Island. *Ibid. 2*: 27–28. E. J. B. Cutler.

The Effect of Seasonal Moisture-deficiency on Yellow-grey Earths. *Ibid. 2*:29–30. I. J. Pohlen.

Effect of Phosphorus and Molybdenum on the Provision of Nitrogen for Pasture. *N.Z. J. Agric. 94*:337–343. R. B. Miller and J. G. H. White.

Clay Mineralogy of New Zealand Soils, Pt. 4—Differential Thermal Analysis. *N.Z. J. Sci. Tech. B38*:533–570. M. Fieldes.

An Examination of the Orr and Bankston Stearic Acid Method of Determining Surface Area of Clays. *Ibid. B38*:588–594. K. S. Birrell.

Identification of Coffinite in Radioactive Rocks of the Buller Gorge Region, New Zealand. *Nature 179*:546. J. J. Reed and G. G. C. Claridge.

Volume Changes in Drained Triaxial Tests on Granular Materials. *Geotechnique 7*:17–34. P. L. Newland and B. H. Allely.

Some Physical Properties of Taupo Pumice Soils. *Soil Sci. 83*:273–288. R. Q. Packard.

Host-endophyte Relationships in Mycorrhiza of *Perneltya macrostiquis*. *New Phytologist 56*:247–254. T. M. Morrison.

Mycorrhiza and Phosphorus Uptake. *Nature 179*:907–908. T. M. Morrison.

Effects of Animals Treading on a Wet Alluvial Soil under Pasture. *N.Z. Soc. Soil Sci. Proc. 2*:37–39. M. W. Gradwell.

Low Temperature Adsorption of Various Gases by Soils. *N.Z. J. Sci. 1*: 70–82. K. S. Birrell and R. Q. Packard.

Corrosion of Mild Steel in Some New Zealand Soils. *Ibid. 1*:52–69. H. R. Penhale.

Pleistocene Shorelines at Porirua Harbour near Wellington. *N.Z. J. Geol. Geophys. 1*:95–102. M. L. Leamy.

The Isolation of Yeasts from Soil *J. Gen. Microbiol. 17*:678–688. 1957. M. E. di Menna.

Soil Development, Shifting Cultivation and Permanent Agriculture in the Humid Tropics. *Agric. J. Fiji 28*:56–61. A. C. S. Wright and I. T. Twyford.

TOBACCO RESEARCH STATION

Director: Mr R. Thomson

PROJECTS

Seedling Bed Work

Alternatives to steam sterilisation for the control of weeds and disease; control of diseases by the use of fungicides; and testing of new insecticides and fungicides on tobacco seedlings.

The Crop in the Field

Fertilisers—Most suitable time and form in which to supply supplementary nitrogen; response of tobacco to minor elements, copper, manganese, zinc, molybdenum; comparison of high-analysis fertilisers with standard mixtures; fertiliser requirements under irrigation; and demonstration plots to illustrate various deficiencies.

Cultural—Effect of spacing plants on size of leaf and total yield, two varieties; control of lateral growth by chemicals; cultivation practices in relation to yield of leaf and spread of mosaic; irrigation studies on the moisture requirements of the tobacco crop; and use of water at planting time.

Plant Breeding—Breeding for resistance to black root-rot, mosaic, verticillium wilt, and *Phytophthora* canker; and studies of inheritance.

Variety Trials—Testing of new overseas varieties and locally developed lines.

Seed Production—Maintaining a supply of seed for the industry and building up a reserve.

Kilns and Curing—Fundamental work on curing in cabinets under controlled conditions; investigation of faults in curing; and technical advice on kiln design.

Insect Pests—Effect on the plant of insecticides in the setting water; and control of root-knot nematodes by soil fumigation.

Diseases—Control of verticillium-wilt organism by soil treatments; persistence of black root-rot in infected soils; use of fungicides to control stem rots and field diseases; and study of kiln conditions conducive to mould development.

WHEAT RESEARCH INSTITUTE

Director: Mr E. W. Hullett

Services—Experimental determination of the milling and baking qualities of new wheats produced at the Crop Research Division; routine wheat and flour testing for millers, bakers, and the Wheat Committee; and technical advisory service for millers, bakers, and other flour users.

Projects—Evaluation of rapid tests for wheat and flour quality; determination of vitamin B_1 content of flours; effects of flour extraction rate on flour quality; analysis of the effects of sifting on flour colour; measurement of relaxation behaviour of doughs; effects on dough of variations in tension imposed by moulders; steam consumption in bakeries; and production planning in mechanised bakeries.

PUBLICATION

Some Flours Improve with G.M.S. *N.Z. Baker and Confectioner* (Aug. 1957). J. Nolan and I. D. Sanders.

INCORPORATED RESEARCH ASSOCIATIONS

THE DAIRY RESEARCH INSTITUTE (N.Z.)

Director: Professor W. Riddet

The financial year of the Institute ends on 31 July next, after which a separate report will be issued. The investigations under way include studies of the following subjects:

Cheesemaking—Use of freeze-drying techniques in the preservation of cheese-starter cultures and phage preparations; the formation of carbon dioxide during the ripening of cheese; changes in the bacterial flora of cheese during the ripening process; the metabolism of the lactobacilli; the chemical nature of cheese flavouring substances; the effect of various modifications in manufacture and in packaging on the incidence of tallowy discoloration in cheese; changes in the oxidisability of fat in cheese during storage; packaging materials for the wrapping of rindless cheese; and moisture loss from waxed cheese.

Buttermaking—Butterfat/water solubility partition coefficients in relation to steam distillation of taints from cream; manufacture of non-washed unsalted butter; manufacture of unsalted starter butter; chlorination of butter wash-water in the manufacture of starter butter; relation of pH of cream at churning to percentage loss of fat in buttermilk; body of butter as affected by temperature treatment of cream; causes of spotted colour in butter; phospholipid content of butter; and methods of improving the quality of whey butter.

Casein—Agitation during the cooking process in relation to solubility of casein; efficiency of washing methods; improvement of drying methods; development of equipment to mechanise casein making; and the recovery of "fines" from whey and waste waters.

Lactalbumin—Precipitation of lactalbumin from casein whey and factors influencing colour of the final product; development of continuous processing; and particle size analysis and effect of particle size on colour.

Dried Milk—Chemistry of changes in dried milk during storage at high atmospheric temperatures; and investigations relating to specialised powders.

Dairy Process Engineering—Study of oil firing for dairy factory boilers; the efficiency of boilers during intermittent operation; the effect of temperature conditions on deterioration of milk quality; and the effect of milk cooling and storage methods on deterioration of milk quality.

Dairy Husbandry—Cause of the regular seasonal changes in the properties of New Zealand butterfat – effect of stage of lactation and of individual grasses in the pasture complex; and effect of oral dosing of cows with penicillin on milk yield and composition, and on butterfat properties.

Engineering Advisory and Service Section—Detailed advisory and consulting work on steam, refrigeration, and processing machinery; and machinery testing for manufacturers.

PUBLICATIONS

The Steam Stripping of Taints from Liquids, Part V—The Basic Design of Cream Deodorising Equipment. *J. Dairy Res., 23*:363 (1956). J. K. Scott.

Steam Costs in New Zealand Cheddar Cheese Manufacture. *Proc. 14th International Dairy Congress 2, Part 2*:799 (1956). J. K. Scott.

Equipment for Deodorising Cream. *Ibid. 2, Part 1*:411 (1956). J. K. Scott.

An Apparatus for Experimental Work on Cream Deodorisation. *Ibid. 2, Part 1*:257 (1956). F. H. McDowall.

Some Colour Defects in Butter. *Ibid. 2, Part 1*:133 (1956). R. M. Dolby.

Non-enzymic Browning: The Reaction Between D-Glucose and Glycine in the "Dry" State. *Biochem. J. 64*:639 (1956). E. L. Richards.

The Influence of Penicillin on the Manufacture and Ripening of Cheddar Cheese. *J. Dairy Res. 23*:355 (1956). H. R. Whitehead and D. J. Lane.

The Influence of Cultural Conditions on the Characteristics of Streptococcus Cremoris. *Ibid. 23*:315 (1956). H. R. Whitehead, C. A. E. Briggs, E. I. Garvie, and L. G. M. Newland.

The Detection of Penicillin in Milk. *J. Appl. Bact. 19*:247 (1956). H. R. Whitehead and G. A. Cox.

Factors Influencing the Vitamin Content of Milk Fat, V—Changes in Vitamin A and Carotenoid Content of the Blood Plasma of Cows and Heifers near Parturition in relation to Secretion of these Substances in the Milk Fat. *J. Dairy Res. 24*:108 (1957). S. Y. Thompson and W. A. McGillivray.

A Rapid Method for Estimating the Size Distribution of Fat Globules in Cream. *Ibid. 24*:68 (1957). R. M. Dolby.

The Effect of pH on the Extent of Splitting or Clumping of Fat Globules Caused by Agitation of Hot Cream. *Ibid. 24*:77 (1957). R. M. Dolby.

Steam Distillation of Taints from Cream, III—Factors Affecting Rate of Removal of the Reference Substances, Diacetyl and Acetoin. *Ibid. 24*:184 (1957). F. H. McDowall.

Multi-stage Counterflow Operation of Vacreators in New Zealand. *Dairy Ind. 22*:482 (1957). J. K. Scott.

The Carbon Dioxide Content of New Zealand Cheddar Cheese. *J. Dairy Res. 24*:235 (1957). P. S. Robertson.

Science in the Development of the Dairy Industry. In "Science in New Zealand." (Prepared for A.N.Z.A.A.S. Conference, 1957). A. H. and A. W. Reed, Wellington, 176–189. W. Riddet.

The Influence of Undernutrition of Dairy Cows on the Yield and Composition of Milk. *N.Z. J. Sci. Tech. A38*:682 (1957). M. R. Patchell.

The Effect of Short Periods of Undernutrition After Calving on the Establishment of Lactation in Dairy Cows. *Ibid. A38*:689 (1957). D. S. Flux and M. R. Patchell.

MEAT INDUSTRY RESEARCH INSTITUTE OF N.Z. (INC.)

Director: Mr N. H. Law

The Institute has now a nucleus staff and is temporarily accommodated in a section of the Dominion Laboratory building at Gracefield. Sketch plans have been approved by the executive for the Institute's permanent laboratories to be erected on a site at Ruakura, Hamilton, where an area of 9½ acres has been acquired from the Department of Agriculture.

Until such time as the Institute is fully established at Ruakura, its research programme must remain somewhat restricted in scope since much of the applied work planned is dependent on the close proximity of an animal research station and a large freezing works. In the meantime, the available resources of the Institute are being devoted to projects of rather a basic nature designed to give information on the biochemistry and biophysics of meat.

PROJECTS

Energy Control in Muscle—A study is being made of the energy control mechanism in muscle, to yield information on muscle composition, the onset of *rigor mortis,* fluid uptake and release by meat, and "thaw *rigor*", and the massive shortening and distortion observed during the thawing of meat frozen before *rigor* onset. This work is in support of the developing interest in faster freezing methods of meat preservation in New Zealand.

Protein Chemistry—Biochemical structural changes occur in muscle during its conditioning or ageing. The action of naturally occurring proteolytic enzymes in structural proteins is being studied with the object of furnishing information on the biochemistry of conditioning.

An understanding of the architecture of the structural proteins of muscle, and the interaction between them, is essential to the interpretation of the physical properties of meat and the changes that occur in its condition.

Microbiology—A survey is being made of bobby veal production with the view of tracing and identifying sources of Salmonella contamination – the ultimate objective being its total elimination.

NEW ZEALAND FERTILISER MANUFACTURERS' RESEARCH ASSOCIATION (INC.)

Director: Dr B. W. Doak

Although Nauru and Ocean rock phosphates have been the main source of raw material for the superphosphate industry for many years, no systematic study has been made of the characteristics of these phosphates when treated with sulphuric acid. The various companies differ considerably so far as strength and temperature of acid used and fineness of grinding of the rock are concerned. While this variation may be necessary in view of differences in equipment, the procedures adopted are largely based on opinion rather than on a proper study of the acidulation process. Further, no differentiation is made in some works between Nauru and Ocean phosphates, although their chemical and physical properties differ considerably. A study is being made using raw phosphate ground to differing fineness, using different acid strengths, and differing rock-acid ratios, with a view to

obtaining data which will allow manufacturers to select the conditions which will give the highest yield of superphosphate of satisfactory physical and chemical composition per ton of rock or of acid. The results so far indicate that the most economical ratio will depend on the relative costs of phosphate rock and sulphur.

With a view to eliminating mixing difficulties with DDT and superphosphate and to reduce the segregation of DDT from superphosphate when distributed from the air, a method of incorporating the DDT during the manufacturing process has been developed. Suppliers of DDT had previously considered that this could not be done without decomposition of DDT at the temperatures reached during the reaction between phosphate rock and acid. The feasibility of incorporating DDT thoroughly without serious loss was examined and a procedure developed which allowed this to be done without loss of DDT. The effectiveness of the so called "wet mix" product for the control of grass grub was tested by the Entomology Division and, as good results were obtained, their recommendations for the control of grass grub have been changed. The effectiveness of this product for the control of cattle tick is under examination at this station, and promising results have been obtained.

PROJECTS

Acidulation studies on Nauru and Ocean rock phosphates; long-term study of effect of continued applications of various phosphates on the chemistry of soils; study of sulphur in soils, rainfall and drainage water; and effectiveness of various granule sizes of granulated superphosphate.

NEW ZEALAND LEATHER AND SHOE RESEARCH ASSOCIATION (INC.)

Director: Mr F. W. Woodroffe

Research conducted by the association in recent years on "hard spot" and other faults occurring in calf skins has produced results which are most valuable for New Zealand's calf-skin export trade. Deterioration of raw skins caused by these faults has been controlled by the use of boric acid and B. Naphthol as an immediate dip process prior to salting. British and continental tanners report that calf skins treated in this manner have been completely free from "hard spot". Work is proceeding along similar lines to overcome deterioration of hides during shipment overseas.

The low-acid process for pickling pelts developed by the association to prevent deterioration is being generally accepted in Europe. Some resistance is still being met in America, although the largest sheep-skin tanner there has expressed a strong preference for pelts treated with the low-acid technique.

A great deal of work has been done on retannage of upper leathers to give fuller leather with a superior cutting area and also on the use of non-reactive resins as filling agents. The leather is less easily wetted and has a lighter base colour, which facilitates the production of pastel shades that are very much in demand at present.

The development of flexible sole leathers is being followed up by trials with impregnating materials to increase water resistance and wear, without impairing flexibility.

The association's work on perspiration damage to footwear, and the production of leathers more resistant to perspiration, is now being applied, and men's shoes are being made which have the semi-chrome insole, rot-proof welt thread, and rot-proof linings.

The number of inquiries dealt with during the year was 478.

PROJECTS

The use of bactericides in salt used for hide curing; the control of "hard spot" by means of boric acid; the use of low-alkali paints in fellmongeries using hydrosulphide, or calcium chloride with sodium sulphide; the use of trichlorphenol in low-acid pickles; the filling of chrome upper leathers with resin dispersions; hydrosulphide unhairing of side leathers; the impregnation of vegetable and chrome retan sole leather to increase waterproof and wear properties; the application of acrylic resins to side leathers to give fast finishes; the controlled lubrication of side and calf leathers; adhesives in footwear manufacture; perspiration-resistant welted shoes; and production and quality control.

PUBLICATION

The Control of Hard Spot and Red Heat on Wet Salted Calfskins. *J. Soc. Leath. Tr. Chem. XLI*:206. F. W. Woodroffe, F. G. Caughley, and M. E. Pattinson.

NEW ZEALAND POTTERY AND CERAMICS RESEARCH ASSOCIATION (INC.)

Director: Mr I. C. McDowall

Early experiments with automatic stokers in the New Zealand clay industry were not successful and in recent years manufacturers have been very reluctant to pursue the matter. Reconsideration of the early trials in the light of modern knowledge of the properties of local coals led to the development of a new type of automatic stoker especially adapted to non-coking coals. The new stoker is a gravity-feed type in which the supply of primary air controls the rate of combustion. Trials on a salt glazed pipe kiln have been very encouraging and there is every indication that the stoker will be accepted by the industry as a useful tool for improving the uniformity of firing, cutting fuel costs, and reducing atmospheric pollution.

PROJECTS

Plastic and drying properties of clay bodies; automatic stokers for firing intermittent kilns; mechanical properties of salt glazed pipes and field tiles; application of reinforced brick construction; investigation of raw material resources; and prediction of firing deformation of ceramic bodies.

PUBLICATIONS

The Mechanism of Filter Pressing and Slip casting. *J. Amer. Ceram. Soc. 40*: (10), 355–362. D. S. Adcock and I. C. McDowall.

Fireplace and Chimney Construction. *Building Progress 22*:(7) 43–49. V. A. Youl.

Laying Firebricks. *Ibid. 22*:(11), 51–61. I. C. Hope.

Reinforced Brickwork. *Ibid. 23*:(1), 38–47. V. A. Youl.

NEW ZEALAND WOOL INDUSTRIES RESEARCH INSTITUTE (INC.)

Director: Dr L. F. Story

Title and Membership—The title has been changed from New Zealand Woollen Mills Research Association consequent upon the admission of woolscourers to membership.

Woollen Spinning—In continuation of work on this subject, mill trials with varying oil contents have shown that stronger and more even yarn, and an increased package density, are obtained with increased oil content. Correlation of the breakage rates and twists with the strength of slubbing as measured at different twists showed that the minimum yarn breakage rate is probably obtainable at a definite slubbing strength. Thus it seems likely that a simple determination of slubbing strength would enable optimum spinning conditions to be predicted.

Combing Oils—A comparison of mineral-based and animal/vegetable-based oils has been made. Differences were small except that noticeably less fly was produced on the comb at a high oil content.

Skew in Weaving—A limited investigation has been made of "skew" in twill cloths, which is troublesome in tailoring the cloths as patterns are difficult to match. However, it was found that skew appears to be inherent in certain cloth constructions and little can be done about it short of altering the cloth.

Copper Content of Fleece Wools—Samples of fleece wool from various sources have been tested for copper content and figures up to 47 p.p.m. were found in samples from sheep that had been dipped in copper-containing dips.

48s Quality New Zealand Wools—Two surveys of wools of these qualities selected by woolstore classers have been made and have shown a considerable range of properties between samples.

Bin Wools—Samples of wool were taken from bins at a woolstore prior to each Dunedin wool sale and showed a marked deterioration in strength during the season 1956–57, the strongest wool being obtained at the October sale. This is in line with our previously reported work on pre-lamb shearing when the wool shorn before lambing (and sold in October) was found to be about 2½ times as strong as similar wool shorn after lambing. Samples are being taken in the current season from seven woolstores, in Dunedin and Christchurch, and are showing a similar trend in strength.

Thyroxine and Iodine Trials—The treated group of the Invermay flock was reimplanted with thyroxine in March 1957, but gave a negligible increase in fleece weight. In a field trial carried out at Geraldine there was also no gain in fleece weight. In another trial at Invermay, groups of sheep were given iodine in three different forms (including thyroxine), but no effects on fleece weight were found.

PROJECTS

Fibre breakage in scouring and carding; examination of bin-wools; effect of thyroxine on wool growth; and survey of wool samples from Romney sheep (with Massey Agricultural College).

PUBLICATIONS

New Zealand 48s Quality Wool. *Wool 2 (5)*:38–44. D. A. Ross.
Rapid Measurement of the Fibre Diameter of Romney Crossbred Wool by the Airflow Apparatus. *N.Z. J. Sci. 1*:127–142. D. A. Ross.

RESEARCH INSTITUTE OF LAUNDERERS, DRYCLEANERS, AND DYERS OF NEW ZEALAND (INC.)

Director: Mr N. S. Whittall

During the year the institute carried out a total of approximately four hundred investigations into causes of damage of clothing during wear, drycleaning, or laundering. A further two hundred investigations were carried out on new materials in respect of serviceability as to wear, dyefastness, shrinkage, etc.

Various washing processes were carried out on blankets with a view to rendering them sterile, but at the same time reducing the shrinkage to a minimum. As a result of these tests a specialised washing technique has been evolved and is in use in most New Zealand hospital laundries. Tests have also been carried out on a shrink-resistant treated blanket. These tests showed that such a blanket could be boiled repeatedly without excessive shrinkage taking place.

Plant visits have been made to the various commercial laundries and drycleaners and also institutional laundries. During these visits tests are carried out to ascertain the efficiency of the particular plant and, where necessary, new or modified processes were introduced. In conjunction with these visits special laundry test pieces are sent out so that a check can be made of plants between visits.

Various conferences have been organised by and held at the institute. A two weeks' training course for laundry personnel was also introduced during the year.

Technical bulletins have been issued on a variety of subjects. These cover recommended processes, techniques, and also defects found with various textiles and garments.

PROJECTS

Investigation of the effect of optical white or fluorescent dyestuffs in washing procedures, and the effect of such dyestuffs on various fabrics; evaluation of washing techniques using standard laundry test pieces; investigation of the depreciation and degradation of various textiles, using different washing techniques; investigation into the degradation of various textiles, using carefully controlled bleach procedures; and production of special test pieces for evaluation of drycleaning processes.

GRANT-AIDED RESEARCH IN OTHER INSTITUTIONS

On p. 8 are shown the annual grants made by the Department to assist research in other institutions.

CANTERBURY AGRICULTURAL COLLEGE

Director: Dr M. M. Burns

PROJECTS

Agricultural Engineering—Small seeds harvesting; reactions of mounted ploughs on tractors; and tractor-guiding instrument.

Agricultural Zoology—White clover case-moth research; thrips infestation of cocksfoot seed crops in Canterbury, Otago, and Southland; and pollination of red clover.

Animal Husbandry—Border Leicester - Romney trial; thyroxine implantation trial; and use of lucerne for flushing ewes.

Field Husbandry—Lucerne pasture mixtures at Ashley Dene; measurement of field production at Ashley Dene; lucerne agronomy trials; improvement and testing of creeping lucernes; physiological studies on lucerne, (a) suckering and rhizomaceous characteristics, (b) inhibition of growth of rhizobium; physiological studies of germination of Californian thistle and the response of the plant to growth regulators; and lucerne establishment.

Microbiology—Studies of the bacterial populations of the wool fleece and of the conditions for growth of *Pseudomonas aeruginosa;* microbiology of foods; *rhizobium* inoculation of legumes; root excretion and rhizosphere; and disease survey and plant pathology.

Soil Science—The nitrogen cycle in grassland soils; the nutrition of legumes; and lime studies.

Valuation and Farm Management—Resource productivity in New Zealand farming.

Veterinary—Investigation of treatments of ovine pregnancy toxaemia.

Wool—Studies in "fleece rot"; and studies on wool break.

PUBLICATIONS

Comparative Efficiency of Two Methods of Harvesting White Clover Seed. *Journal of Agricultural Engineering Research, 2*:No. 3, 1957. A. W. Riddolls and D. L. King.

Forces that Affect the Stability of a Tractor. *Canterbury Agricultural College Technical Publication No. 16.* D. L. King.

Border Leicester Cross Ewes for Fat Lamb Production. *N.Z. J. Sci. Tech. 38A*:966–986; *Proc. N.Z. Soc. Anim. Prod. 17*:89–95. I. E. Coop.

Breeds of Rams for Fat Lamb Production. *N.Z. J. Sci. Tech. (1957) 38A*:928–946. I. E. Coop and V. R. Clark.

Bacteria in Clover Root Tissue. *Canadian J. Microbiology 3*:125–129. 1957. M. N. Philipson and I. D. Blair.

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CAWTHRON INSTITUTE

Director: Dr D. Miller

The grant-in-aid from the Department of Scientific and Industrial Research has been devoted to researches on plant nutrition concerned with hops, tobacco, soils, fruits, and tomatoes. Collaboration with the Hop and Tobacco Research Stations at Riwaka has been maintained.

PROJECTS

Hop Research—Field work has included fertiliser trials with major and minor elements, combined with studies in the rate of growth and changes in the chemical composition of cones. Chemical examinations have been made of material secured from magnesium trials and molybdenum deficiency experiments. A pattern of seasonal variation, probably connected with plant development, has been shown by a study of the sugars in hop roots from different depths and over a period. Analyses of cured hops from the Hop Research Station for resin content have been continued. The study of the influence of organic fertilisers on the incidence of black root-rot has been carried to the stage which suggests that the fungus is better able to utilise organic than inorganic sources of nitrogen.

Tobacco Research—Researches in conjunction with the Tobacco Research Station have been concerned with the effect, on nutrition and quality, of major and minor elements, irrigation, spacing, and curing. In relation to diseases, a new departure has been the chemical examination of plants bred for resistance to black root-rot and mosaic. The mycologist has dealt with wilt, butt-rot, and general disease surveys.

Soil Investigations—Work has been carried out on soil problems related to the plant nutritional researches on hops and tobacco. The Eastern Hills survey has been published as a bulletin, and a survey, particularly of the alluvial soils of the Waimea County, is being prepared for publication.

Fruit Research—The experiments have continued on the nutrition of raspberries and other small fruit and apples involving fertiliser, trace element and mulching trials. A new study has been into the incidence of bitter pit of apples from a biochemical approach.

Tomato Research—Work is advancing in the water-culture experiments in relation to the hard-core and cloud nutritional disorders of tomatoes. The influence of various trace elements has been studied as well as that of light intensity and humidity.

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MASSEY AGRICULTURAL COLLEGE

Principal: Professor G. S. Peren

PROJECTS

Agricultural Biochemistry—Wear in sheep's teeth; utilisation of carotene by animals; investigation of methods of milk analysis; and determination of minimum frequency of sampling for obtaining significant data.

Agricultural Zoology—Investigations on possible inhibition of stomach worm *(Haemonchus)* parasitism in sheep grazing certain grasses and clovers in pure stand; the process of development of resistance to parasitism; the epidemiology of round worm parasitism in sheep; and distribution of bumble bee species in the South Island.

Dairy Husbandry—Study of endocrine factors in relation to mammary gland growth; investigation of a method for inducing mammary gland growth in ruminants; investigation and use of the Hooker-Forbes biological method for estimating progesterone in the circulation of animals; in cooperation with the Plant Chemistry Division, investigation of the effect of the cyanogenetic glucocide in white clover on the thyroids of animals; and the nutritive value of whey for fattening pigs.

Sheep Husbandry—Sheep breeding experiment; genetics of *N*-type and horns; carcass quality and meat investigations; and endocrinology of reproduction in the sheep.

Soils and Field Husbandry—Mole drainage; tile drainage; pampas research; and pasture manuring under rotational grazing.

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UNIVERSITY OF CANTERBURY INDUSTRIAL DEVELOPMENT DEPARTMENT

Director: Mr T. R. Pollard

The operation over the past year has again been sound financially and has shown a further increase in the work being done for industry. The total financial recovery for the year was £19,000, as compared with £19,200 for the previous year. The industrial recovery was £7,700, as compared with £5,000 for the last year. The Government recovery figure was still high (£8,700), this being mainly the final sum for the

I.G.Y. programme. Gross expenditure was £27,100; the organisation thus operated within its estimated grant of £8,000. The number of projects undertaken for industry over the last 13 months was 930, compared with 600 for the previous period.

It is interesting to note at this stage that the number of projects carried out for industry from the commencement in 1948 totals 3,630, and the total number of firms that have made use of the service over this period is 920.

The work has shown constant expansion for several years. Over the last five years industrial and Government recoveries have totalled £65,509 and, over the same period, the grants have totalled £33,000.

PROJECTS

The radio ionosondes which involved I.D.D. in so much work during 1956 and 1957 have been in continuous operation for approximately 18 months and their performance has been practically 100 per cent. The continuity of their operation in the Antarctic has been most satisfactory.

Modifications have been carried out on a radiation detector on a dredger using a higher power source. A certain amount of difficulty was experienced in using the Geiger tubes in parallel, but the set has now been running for some months and performing satisfactorily. Negotiations are still going on with Dutch and Italian firms. A certain amount of experimental work has been carried out and an analysis made, and these firms have been quoted for the higher power apparatus necessary for their large pipes. An English firm of electronic engineers, who wish to acquire the rights for manufacture and distribution of this instrument, have inquired regarding the patent licence.

A considerable amount of work has been carried out on the testing of electric blankets; to date, 62 types of electric blanket have been tested. The causes of a number of electrical fires have been investigated and at a recent meeting convened by the New Zealand Standards Institute it was decided to authorise a grant of £500 to enable I.D.D. to investigate still further the causes of fires.

Design work is proceeding on a complete dynamic balancing machine for a Christchurch firm.

Temperature control apparatus for an extrusion-moulding machine has been developed and made for another Christchurch firm.

Research apparatus for determining the life of fluorescent materials has been made for the Chemistry Department of the University of Canterbury.

Work is proceeding on the design of a high-power, high-speed, double-flash photographic unit. This apparatus, which is being made for the Chemical Engineering Department, allows two high-speed photographs to be taken with a variable delay between them.

The balance of the scientific apparatus for the Royal College of Medicine at Baghdad has been packed and forwarded.

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